Nokia Customer Care

Service Manual

RM-194 (Nokia N77; L3&4)

Mobile Terminal

Part No: 9254840 (Issue 1)

COMPANY CONFIDENTIAL

Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	04/2007	TSa	

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IMPORTANT

This document is intended for use by qualified service personnel only.

Warnings and cautions

Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.

ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.

Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.

Company Policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Business Group should be notified in writing/e-mail.

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- Title of the Document + Issue Number/Date of publication
- Latest Amendment Number (if applicable)
- Page(s) and/or Figure(s) in error

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Battery information

Note: A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Ni-Cd/NiMh batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.

Nokia N77; L3&4 Service Manual Structure

1 General Information
2 Service Tools and Service Concepts
3 BB Troubleshooting and Manual Tuning Guide
4 RF Troubleshooting and Manual Tuning Guide
5 Camera Module Troubleshooting
6 TV troubleshooting
7 System Module
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1 — General Information

(2)Sports Channel 2
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LIVE
Sport: Player penalty
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NOKIA
N77

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RM-194/RM-195 product selection

The Nokia RM-194 is a GSM/WCDMA dual mode handportable phone supporting EGSM900/1800/1900 and WCDMA 2100 (UMTS). The RM-195 variant does not support WCDMA radio interface and related services.

Note: All subsequent references to WCDMA or related services concern RM-194 only.

RM-194 is a 3GPP Release 99H terminal supporting WCDMA, EGPRS and GPRS data bearers. For WCDMA the maximum bit rate is up to 384 kbps for downlink and 384 kbps for uplink with simultaneous CS speech (64 kbps). For GSM networks RM-194 supports EGPRS multislot class 11 (4+3, max 5) and DTM multislot class 9 (3 +2, max 5).

The device has also an itegrated DVB-H.

RM-194 supports two way video calls with two integrated cameras. Nokia RM-194 is an MMS (Multimedia Messaging Service) enabled phone with a large bright colour display and an integrated 2.0 megapixel digital camera. The MMS implementation follows the OMA MMS standard release 1.2. The WAP 2.0 compatible Browser supports XHTML Mobile Profile (MP) and uses a TCP/IP stack to communicate with a gateway in network.

The handset uses Symbian 9.1 operating system and supports also MIDP Java 2.0 & CLDC1.1, providing an excellent platform for 3rd party applications.

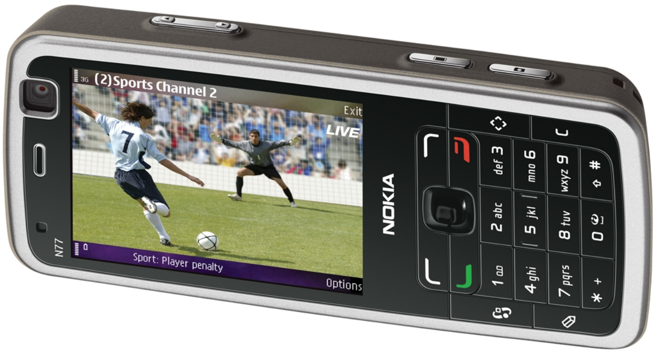

Figure 1 View of RM-194/195

Product features and sales package

Display and user interface

- QVGA display (240x320, up to 16M colours)
- Automatic brightness control for display
- joystick, two softkeys, application-key, edit and clear key, send & end key, multimedia key
- Dedicated capture key, zoom/volume keys and TV key
- System: EGSM900/1800/1900 + WCDMA 2100 GHz, DVB-H
- User interface: S60 software on Symbian OS

Imaging and video

- Integrated 2 Megapixel camera with up to 20 x digital zoom
- Landscape capture with dedicated capture key
- High-quality video capture in MP4 and 3GP formats with up to 8x digital zoom
- Image and video editors
- Nokia Lifeblog

- Image and video uploading to the web

Entertainment

- Integrated digital music player with stereo audio. Supported file formats: MP3, AAC, eAAC+ and wma
- USB mass storage that enables easy drag and drop of files, such as music tracks
- Stereo FM radio with support for Visual Radio
- Multimedia player (RealPlayer) with 3GPP & MPEG4 AVC video streaming support
- Internet browser

Productivity

- Office document viewers (Microsoft Word, PowerPoint, Excel) and PDF reader
- NSuite connectivity with USB, Bluetooth wireless technology
- Advanced S60 PIM (calendar, contacts, task list, PIM printing, etc.)
- Voice recording, dialing and voice commands
- SettingWizard for easy settings configuration

Messaging

- E-mail with document viewers to view attachments
- SMS, multimedia messaging (MMS)

Memory functions

- Up to 42 MB of internal dynamic memory for images, contacts, text messages, multimedia messages, ringing tones, images, video clips, calendar notes, to-do list and applications. Please note that the preinstalled applications on the user data area of the device memory will reduce the informed amount of available memory, unless uninstalled.
- Expandable memory: MicroSD card up to 2G *
- Micro SD card up to 2G

*The availability of a memory card and memory capacity of the card in the sales package may vary depending on the market and/or your network operator/service provider.

Connectivity

- Bluetooth wireless technology
- Pop-Port™ with USB 2.0 Full Speed with mass storage class

Operating frequency and data transfer

- WCDMA2100 and quadband GSM/EDGE (EGSM900/1800/1900) WCDMA2100 with simultaneous voice and packet data (PS max speed UL/DL= 384/384 kbps, CS max speed 64 kpbs)
- EGPRS (Class A, Multislot class 11) – Max download 236.8 kbps; upload 118.4 kbps
- Data transfer (from compatible S40 and S60 phones)

Java

- Java™ MIDP 2.0, CLDC 1.1
- Over-the-air download of Java™-based applications and games

Sales package

- Transceiver

- Charger (AC-4)
- Battery (BP-6M)
- Stereo headset (HS-28)
- Connectivity cable (CA-53)
- Charging adapter (CA-44)
- Adapter AD-41

Mobile enhancements

Table 1 Audio and BT

Enhancement	Type
Classic stereo headset	HS-23
Music stereo headset	HS-28+AD-41
Mono Headset	HS-5
Boom Headset	HDB-4
Fashion Stereo Headset	HS-31
Wireless Headset	HS-26W
Wireless Headset	HS-11W
Wireless Clip-on Headset	HS-21W
Wireless Headset	HS-36W
Wireless Headset	HS-37W
Wireless Headset	HS-53W
Wireless Headset	HS-55W
Wireless Headset	HS-54W
Wireless Headset	HS-56W
Bluetooth Headset BH-100	HS-78W
Bluetooth Headset BH-200	HS-58W
Bluetooth Headset BH-201	HS-52W
Bluetooth Headset BH-202	HS-38W
Bluetooth Headset BH-207	HS-86W
Bluetooth Headset BH-700	HS-57W
Bluetooth Headset BH-300	HS-50W
Bluetooth Headset BH-301	HS-51W
Bluetooth Headset BH-302	HS-73W
Bluetooth Headset BH-303	HS-30W
Bluetooth Headset BH-600	HS-59W
Bluetooth Headset BH-701	HS-74W
Bluetooth headset BH-800	HS-24W

Enhancement	Type
Bluetooth headset BH-801	HS-64
Bluetooth Headset BH-900	HS-25W
3.5mm headphone	HS-61
3.5mm headphone	HS-62
Audio Adapter	AD-15
Audio Adapter	AD-46
Music Speaker	MD-3
Music Speaker	MD-4
TTY Adapter	HDA-10
Loopset	LPS-4
Plug in Car Kit with DPS	HF-33W
Audio gateway	AD-42W
BT keyboard	SU-8W
BT GPS module	LD-3W
GPS module	LD-2
Digital pen	SU-27W

Table 2 Car

Enhancement	Type
Mobile charger	DC-4
Headrest handsfree	BHF-3
Basic handsfree	HF-3
Advanced car kit (sales pack)	CK-7W
Nokia 616 car kit	N616
Basic car kit	CK-10
Wireless plug-in car handsfree	HF-6W
Universal holder	CR-39
Car phone with remote SIM or standard hands-free car kit	RV-1

Table 3 Carrying

Enhancement	Type
Multicompatible carrying case	CP-93
Inbox strap	CP-134
Lens cloth	CL-3

Table 4 Data

Enhancement	Type
Micro SD card 128 MB	MU-26
Micro SD card 256 MB	MU-27
Micro SD card 512 MB	MU-28
Micro SD card 1GB	MU-22
Micro SD card 2G	MU-37
Charging connectivity cable	CA-70
Connectivity cable	CA-53

Table 5 Deskstands

Enhancement	Type
Universal passive deskstand	DT-13

Table 6 Imaging

Enhancement	Type
Nokia image album	PD-1
Nokia remote camera	PT-6

Table 7 Messaging

Enhancement	Type
Nokia digital pen	SU-1B
Bluetooth QWERTY keypad	SU-8W

Table 8 Positioning

Enhancement	Type
Wireless GPS Module	LD-1W
Wireless GPS Module update	LD-3W

Table 9 Power

Enhancement	Type
Battery 1100 mAh Li-ion	BP-6M
Compact charger	AC-3
Travel charger	AC-4
Travel charger	AC-5

Enhancement	Type
Travel charger	DC-4
Charging adapter	CA-44

Technical specifications

Transceiver general specifications

Unit	Dimensions (L x W x T) (mm)	Weight (g)	Volume (cm3)
Transceiver with BP-6M 1100 mAh li-ion battery back	111 x 50 x 18.8 mm	114	92

Main RF characteristics for triple-band (EGSM900/GSM1800/GSM1900) and WCDMA phones

Parameter	Unit
Cellular system	EGSM900, GSM1800/1900 and WCDMA
Rx frequency band	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA: 2110 - 2170 MHz
Tx frequency band	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
	WCDMA: 1920 - 1980 MHz
Output power	GSM900: +5 ... +33dBm/3.2mW ... 2W
	GSM1800: +0 ... +30dBm/1.0mW ... 1W
	GSM1900: +0 ... +30dBm/1.0mW ... 1W
	WCDMA -50 ... -24 dBm
Number of RF channels	GSM900: 125
	GSM1800: 375
	GSM1900: 300
	WCDMA: 277
Channel spacing	200 kHz
Number of Tx power levels	GSM900: 15
	GSM1800: 16
	GSM1900: 16

Battery endurance

Battery	Capacity (mAh)	Talk time	Stand-by	Mobile TV	MP3 playback
BP-6M	1100	210 min (WCDMA)/270 min(GSM)	7.5 days (WCDMA & GSM)	5 Hours	11 Hours with inbox headset*

*With inbox battery. Variation in operation times will occur depending on SIM card, network settings and usage.

Charging times

AC-4
up to 90 min

Environmental conditions

Environmental condition	Ambient temperature	Notes
Normal operation	-15°C...+55°C	Specifications fulfilled
Reduced performance	-25°C...-15°C +55°C...+70°C	Operational for shorts periods only
Intermittent operation	-40°C...-15°C +70°C...+85 °C	Operation not guaranteed but an attempt to operate does not damage the phone.
No operation or storage	<-40°C...>+85°C	No storage or operation: an attempt may damage the phone.
Charging allowed	-25°C...+50°C	
Long term storage conditions	0°C...+85°C	

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2 — Service Tools and Service Concepts

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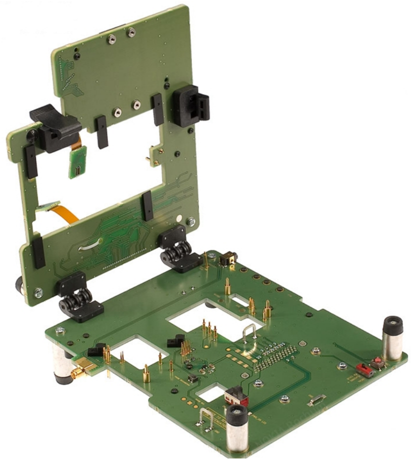
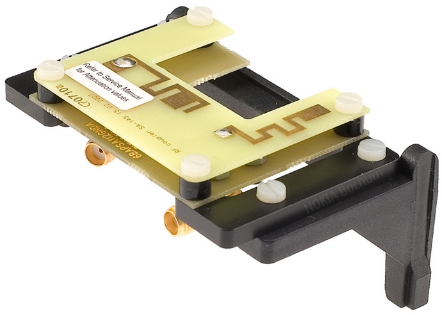
New service tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-194, refer to various concepts.

<table>
<tr><td rowspan="2"> </td><td>FS-46</td><td>Flash adapter</td><td></td></tr>
<tr><td colspan="3">Flash adapter FS-46 is used for phone testing and flashing.
FS-46 is used with the generic flash adapter base SS-60/62 and control Unit CU-4 or interface adapter SS-46. When flashing or system testing the phone, the adapter is attached to replace the phone's own battery.
All functions (as well as the calibration voltages, current and the protections for over voltages, over current and voltage polarity), are performed by CU-4.
Flash adapter FS-46 main features:
• VBATT supply interface
• USB / FBUS multiplexed interface to the phone
• Supply voltage for light source</td></tr>
<tr><td rowspan="2"></td><td>MJ-123</td><td>Module jig</td><td></td></tr>
<tr><td colspan="3">The MJ-123 module jig is used for testing the following modules:
• User interface
• Baseband and RF on system module
Note: The nominal supply voltage for MJ-123 is +6.0 V. The supply voltage must not exceed +12.0 V (min. 5.0 V).
Supply the power to the jig only when the jumper is open = regulated.</td></tr>
<tr><td rowspan="2"> </td><td>RJ-192</td><td>Soldering jig</td><td></td></tr>
<tr><td colspan="3">RJ-192 is a soldering jig used for soldering and as a rework jig for the engine module.</td></tr>
</table>

<table>
<tr><td rowspan="2"></td><td>SA-145</td><td>RF coupler</td><td></td></tr>
<tr><td colspan="3">SA-145 is an RF coupler for WCDMA and GSM RF testing. It is used together with the product-specific flash adapter.</td></tr>
</table>

Common service tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-194, refer to various concepts.

<table>
<tr><td rowspan="2"> </td><td>CA-31D</td><td>USB cable</td><td></td></tr>
<tr><td colspan="3">The CA-31D USB cable is used to connect FPS-10 or FPS-11 to a PC. It is included in the FPS-10 and FPS-11 sales packages.</td></tr>
<tr><td rowspan="2"> </td><td>CA-35S</td><td>Power cable</td><td></td></tr>
<tr><td colspan="3">CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter.</td></tr>
</table>

CU-4	Control unit	

CU-4 is a general service tool used with a module jig and/or a flash adapter. It requires an external 12 V power supply.

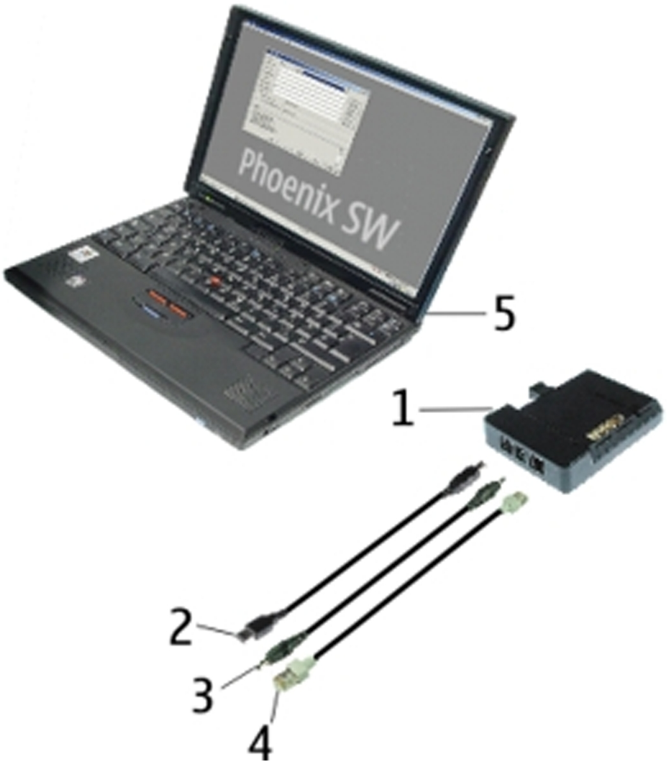
The unit has the following features:

- software controlled via USB
- EM calibration function
- Forwards FBUS/Flashbus traffic to/from terminal
- Forwards USB traffic to/from terminal
- software controlled BSI values
- regulated VBATT voltage
- 2 x USB2.0 connector (Hub)
- FBUS and USB connections supported

When using CU-4, note the special order of connecting cables and other service equipment:

Instructions

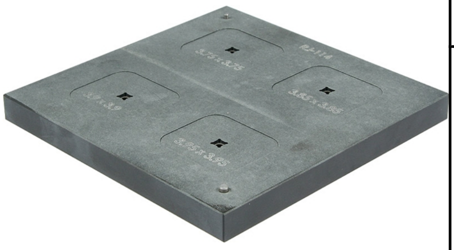
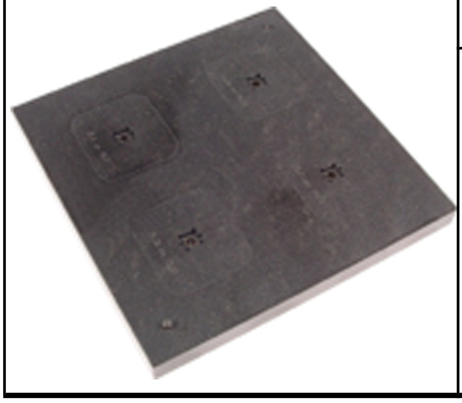
1 Connect a service tool (jig, flash adapter) to CU-4.
2 Connect CU-4 to your PC with a USB cable.
3 Connect supply voltage (12 V)
4 Connect an FBUS cable (if necessary).
5 Start Phoenix service software.

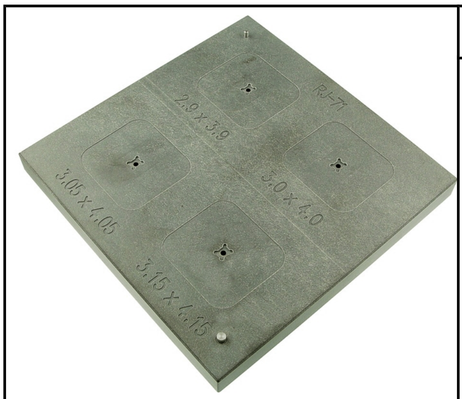


Note: Phoenix enables CU-4 regulators via USB when it is started.

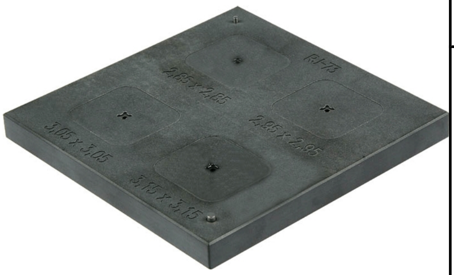
Reconnecting the power supply requires a Phoenix restart.

	DKU-2	USB connectivity cable	
	USB to system connector cable.		
	FPS-10	Flash prommer	
	FPS-10 interfaces with: • PC • Control unit • Flash adapter • Smart card FPS-10 flash prommer features: • Flash functionality for BB5 and DCT-4 terminals • Smart Card reader for SX-2 or SX-4 • USB traffic forwarding • USB to FBUS/Flashbus conversion • LAN to FBUS/Flashbus and USB conversion • Vusb output switchable by PC command FPS-10 sales package includes: • FPS-10 prommer • Power Supply with 5 country specific cords • USB cable		

<table>
<tr><td rowspan="2"> </td><td>PCS-1</td><td>Power cable</td><td></td></tr>
<tr><td colspan="3">The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.</td></tr>
<tr><td rowspan="2"> </td><td>PKD-1</td><td>SW security device</td><td></td></tr>
<tr><td colspan="3">SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC.
Without the device, it is not possible to use the service software.
Printer or any such device can be connected to the PC through the device if needed.</td></tr>
<tr><td rowspan="2"></td><td>RJ-114</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-114 is a rework jig used with ST-41.</td></tr>
<tr><td rowspan="2"></td><td>RJ-57</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-57 is a rework jig used with ST-22.</td></tr>
</table>

<table>
<tr><td rowspan="2">

RJ-71
2.9 x 3.9
3.0 x 4.0
3.05 x 4.05
3.15 x 4.15

</td><td>RJ-71</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-71 is a rework jig used with ST-26 rework stencil.</td></tr>
<tr><td rowspan="2">

RJ-73
3.05 x 3.05
2.95 x 2.95
3.15 x 3.15

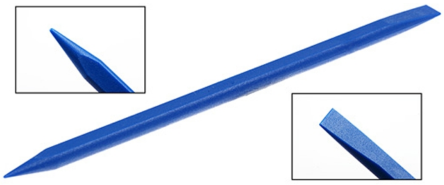
</td><td>RJ-73</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="2"> </td><td>RJ-75</td><td>Soldering jig</td><td></td></tr>
<tr><td colspan="3">RJ-75 is a soldering jig used for soldering and as a rework jig for the engine module.</td></tr>
<tr><td rowspan="2">

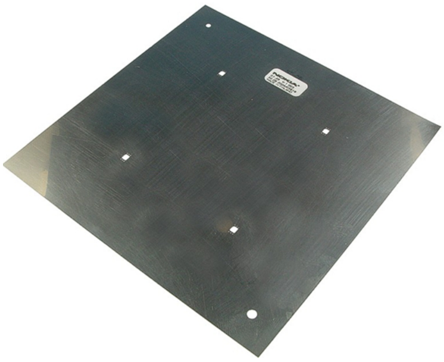
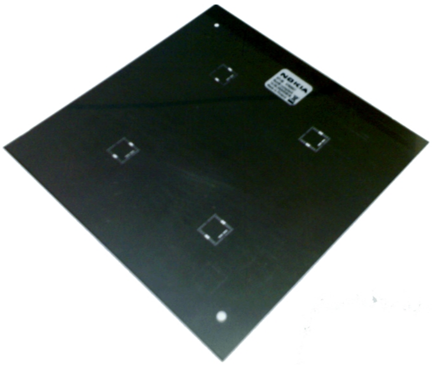
NOKIA
RADIO
CLASS 1
STATUS
BER TEST
FBUS
POWER

</td><td>SB-6</td><td>Bluetooth tester</td><td></td></tr>
<tr><td colspan="3">The SB-6 test box is a generic device to perform Bluetooth bit error rate testing and doing cordless FBUS connection via Bluetooth.</td></tr>
<tr><td rowspan="2">

NOKIA
SPS-2 0770471
Made in Finland

</td><td>SPS-2</td><td>Soldering paste spreader</td><td></td></tr>
<tr><td colspan="3"></td></tr>
</table>

	SRT-6	Opening tool	
	SRT-6 is used to open phone covers.		
	SS-46	Interface adapter	
	SS-46 acts as an interface adapter between the flash adapter and FPS-10.		
	SS-62	Generic flash adapter base for BB5	
	• generic base for flash adapters and couplers • SS-62 equipped with a clip interlock system • provides standardised interface towards Control Unit • provides RF connection using galvanic connector or coupler • multiplexing between USB and FBUS media, controlled by VUSB		
	SS-93	Opening tool	
	SS-93 is used for opening JAE connectors.		
	ST-20	Rework stencil	
	ST-20 is used with RJ-73 rework jig.		

	ST-26	Rework stencil	
	ST-26 is a rework stencil used with rework jig RJ-71.		
	ST-36	Rework stencil	
	ST-36 is a rework stencil used with rework jig RJ-103.		
	ST-41	Rework stencil	
	ST-41 is a rework stencil used with rework jig RJ-114.		
	ST-44	Rework stencil	
	ST-44 is a rework stencil used with rework jig RJ-57.		
	SX-4	Smart card	
	SX-4 is a BB5 security device used to protect critical features in tuning and testing. SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed.		

<table>
<tr><td rowspan="2"> </td><td>XCS-1</td><td>Service cable</td><td></td></tr>
<tr><td colspan="3">The XCS-1 service cable is used to connect FLS-4S to the POS flash adapter for supplying a controlled operating voltage and data connection.</td></tr>
<tr><td rowspan="2"> </td><td>XCS-4</td><td>Modular cable</td><td></td></tr>
<tr><td colspan="3">XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.</td></tr>
<tr><td rowspan="2"> </td><td>XRS-6</td><td>RF cable</td><td></td></tr>
<tr><td colspan="3">The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.
SMA to N-Connector approximately 610 mm.
Attenuation for:
• GSM850/900: 0.3+-0.1 dB
• GSM1800/1900: 0.5+-0.1 dB
• WLAN: 0.6+-0.1dB</td></tr>
</table>

Service concepts

POS (Point of Sale) flash concept

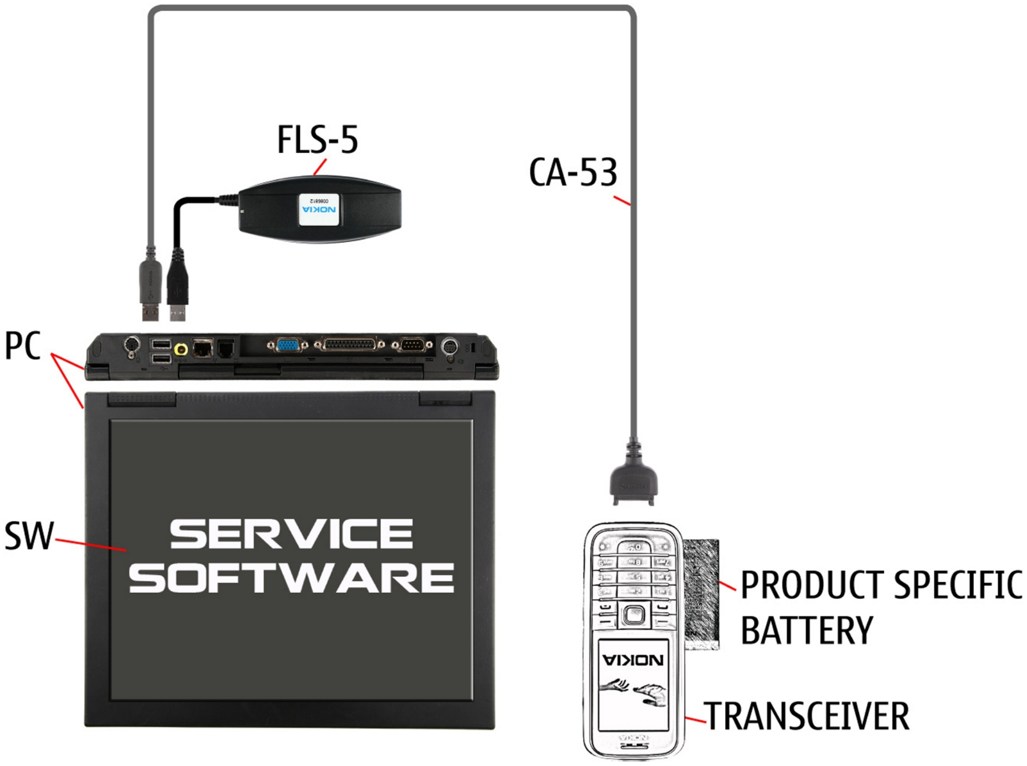

FLS-5
CA-53
PC
SW
SERVICE SOFTWARE
PRODUCT SPECIFIC BATTERY
TRANSCEIVER

Figure 2 POS flash concept

Type	Description
Product specific tools	
BP-6M	Battery
Other tools	
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
CA-53	USB connectivity cable

Module jig service concept

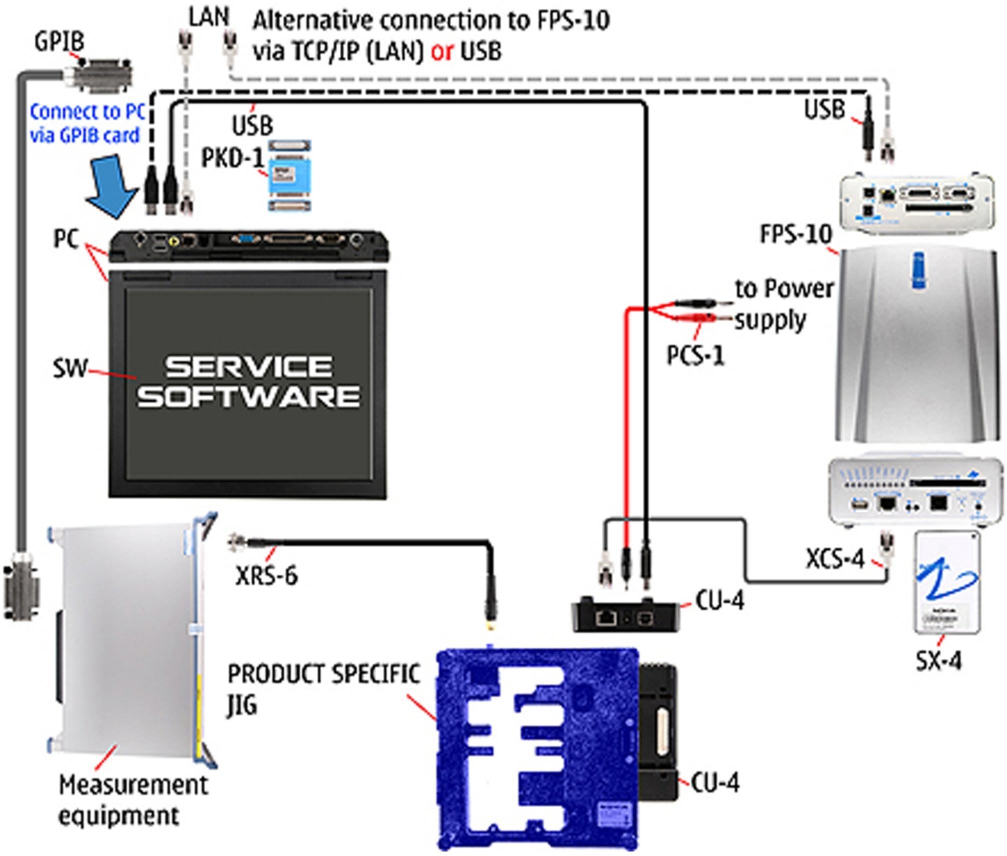

GPIB
LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC
JIG
Measurement
equipment
CU-4

Figure 3 Module jig service concept

Type	Description
Phone specific tools	
MJ-123	Module jig
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SX-4	Smart card
	PC with Phoenix service software
	Measurement equipment
Cables	
PCS-1	DC power cable
XCS-4	Modular cable
XRS-6	RF cable
	USB cable

Type	Description
	GPIB control cable

Service concept for RF testing and RF/BB tuning

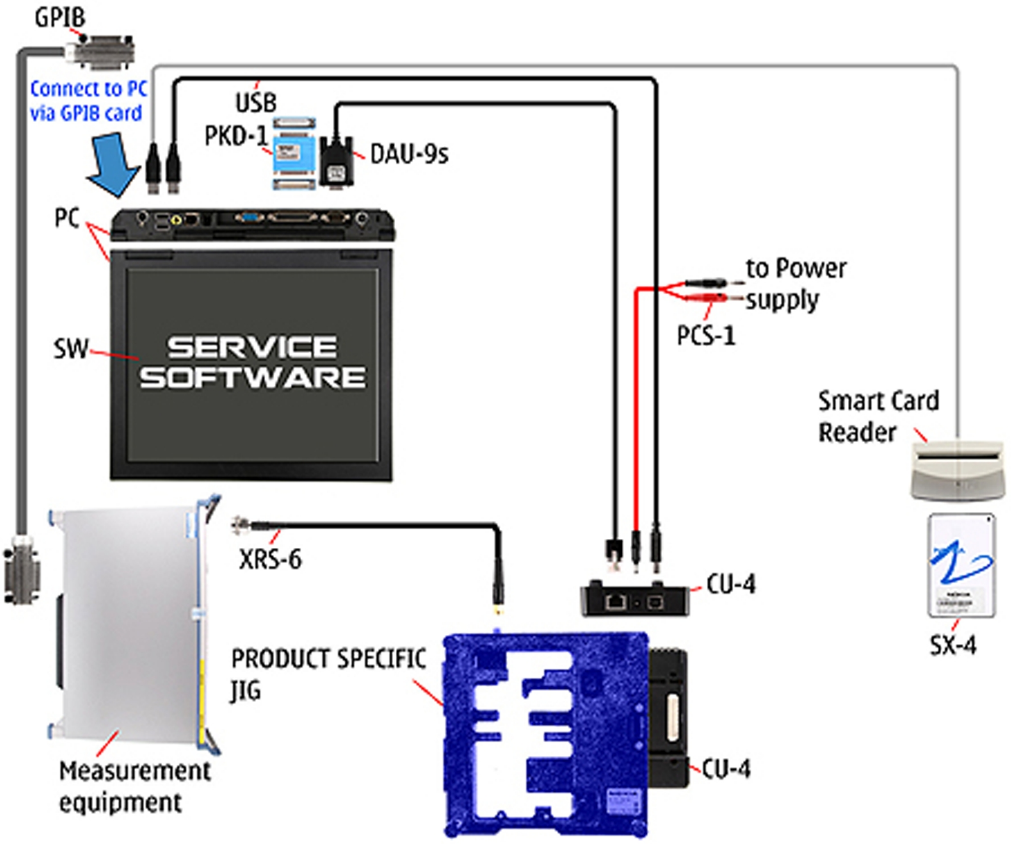

GPIB
Connect to PC via GPIB card
USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
to Power supply
PCS-1
Smart Card Reader
XRS-6
CU-4
SX-4
PRODUCT SPECIFIC JIG
Measurement equipment
CU-4

Figure 4 Service concept for RF testing and RF/BB tuning

Type	Description
Product specific tools	
MJ-123	Module jig
Other tools	
CU-4	Control unit
PKD-1/PK-1	SW security device
SX-4	Smart card
	Measurement equipment
	Smart card reader
	PC with Phoenix service software
Cables	
DAU-9s	MBUS cable
PCS-1	DC power cable

Type	Description
XRS-6	RF cable
	GPIB control cable
	USB cable

Flash concept with FPS-10

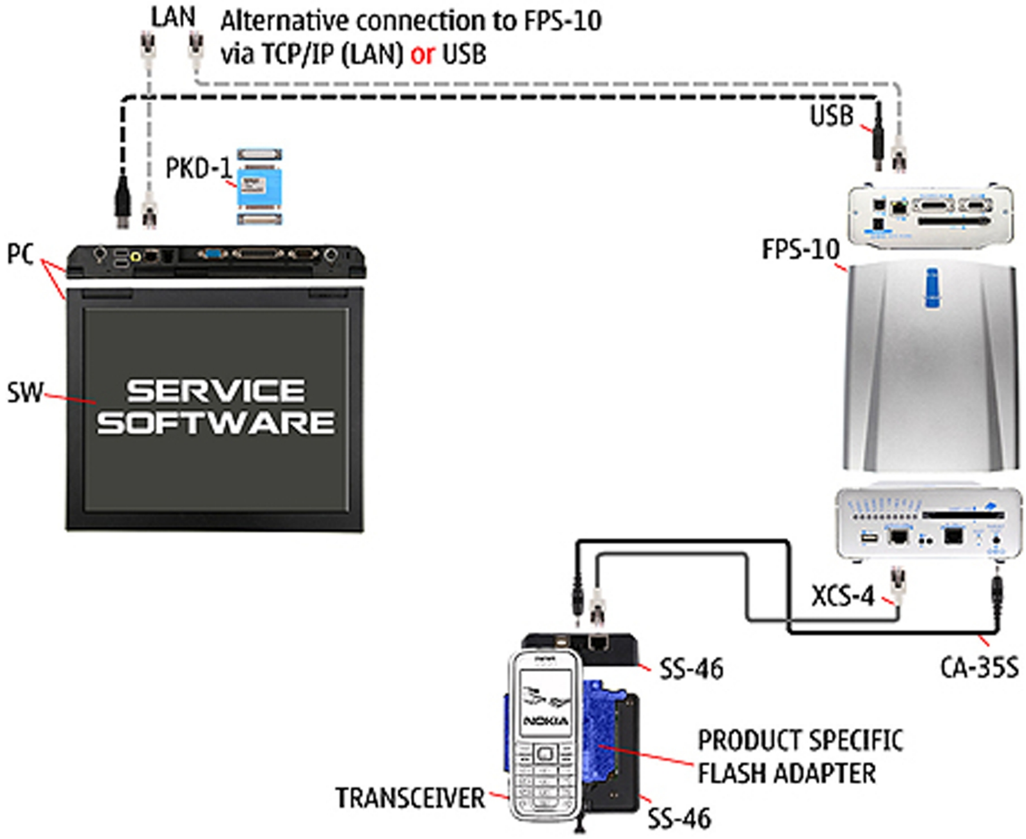

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
PC
SW
SERVICE
SOFTWARE
FPS-10
XCS-4
CA-35S
SS-46
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
SS-46
NOKIA

Figure 5 Basic flash concept with FPS-10

Type	Description
Product specific tools	
FS-46	Flash adapter
Other tools	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable

Type	Description
	USB cable

RF testing concept with RF coupler

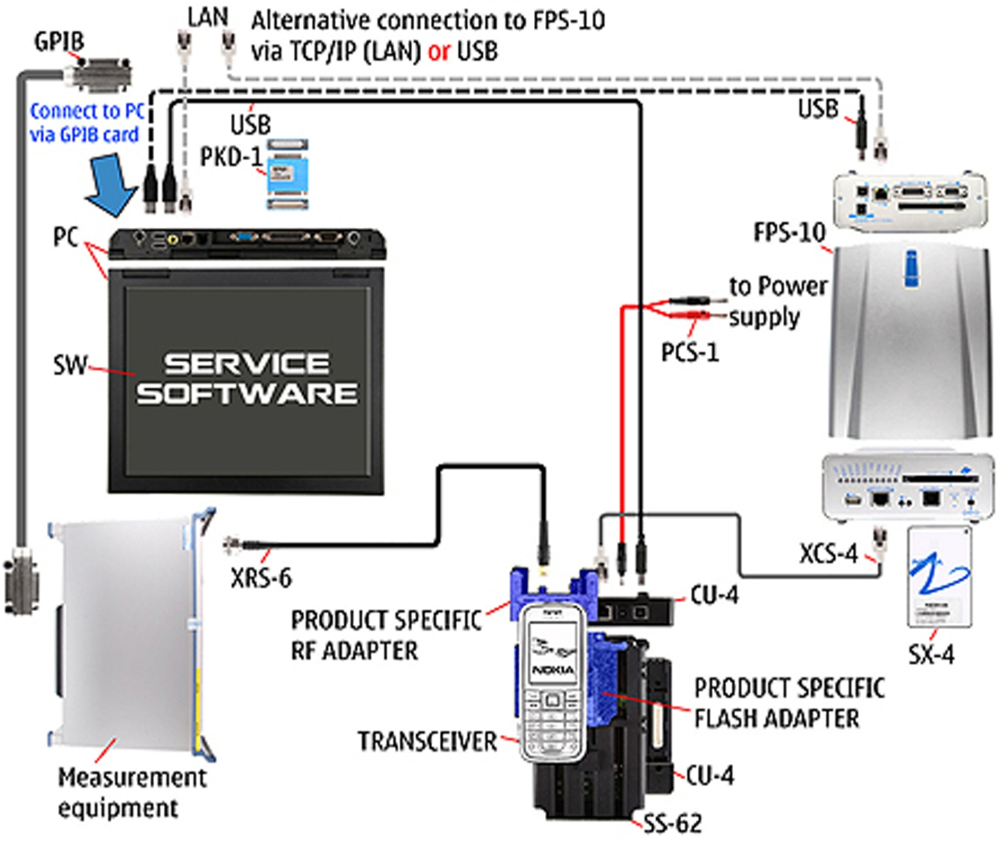

GPIB
LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
XCS-4
CU-4
PRODUCT SPECIFIC
RF ADAPTER
SX-4
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
CU-4
Measurement
equipment
SS-62

Figure 6 RF testing concept with RF coupler

Type	Description
Product specific tools	
FS-46	Flash adapter
SA-xxx	RF coupler
Other tools	
CU-4	Control unit
SX-4	Smart card
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
	Measurement equipment
	PC with Phoenix service software
Cables	
PCS-1	Power cable

Type	Description
XCS-4	Modular cable
XRS-6	RF cable
	GPIB control cable
	USB cable

CU-4 flash concept with FPS-10

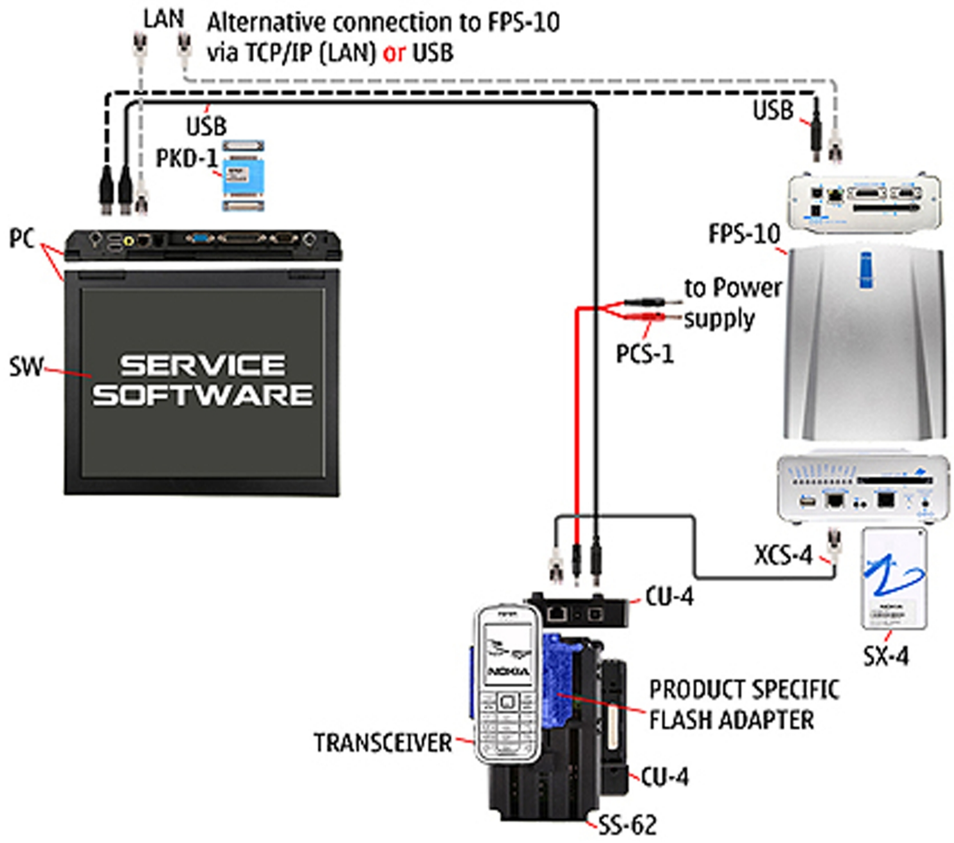

LAN
Alternative connection to FPS-10 via TCP/IP (LAN) or USB
USB
USB
PKD-1
PC
FPS-10
to Power supply
PCS-1
SW
SERVICE SOFTWARE
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC FLASH ADAPTER
TRANSCEIVER
CU-4
SS-62

Figure 7 CU-4 flash concept with FPS-10

Type	Description
Product specific tools	
FS-46	Flash adapter
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	

Type	Description
PCS-1	Power cable
XCS-4	Modular cable
	Standard USB cable
	USB cable

3 — BB Troubleshooting and Manual Tuning Guide

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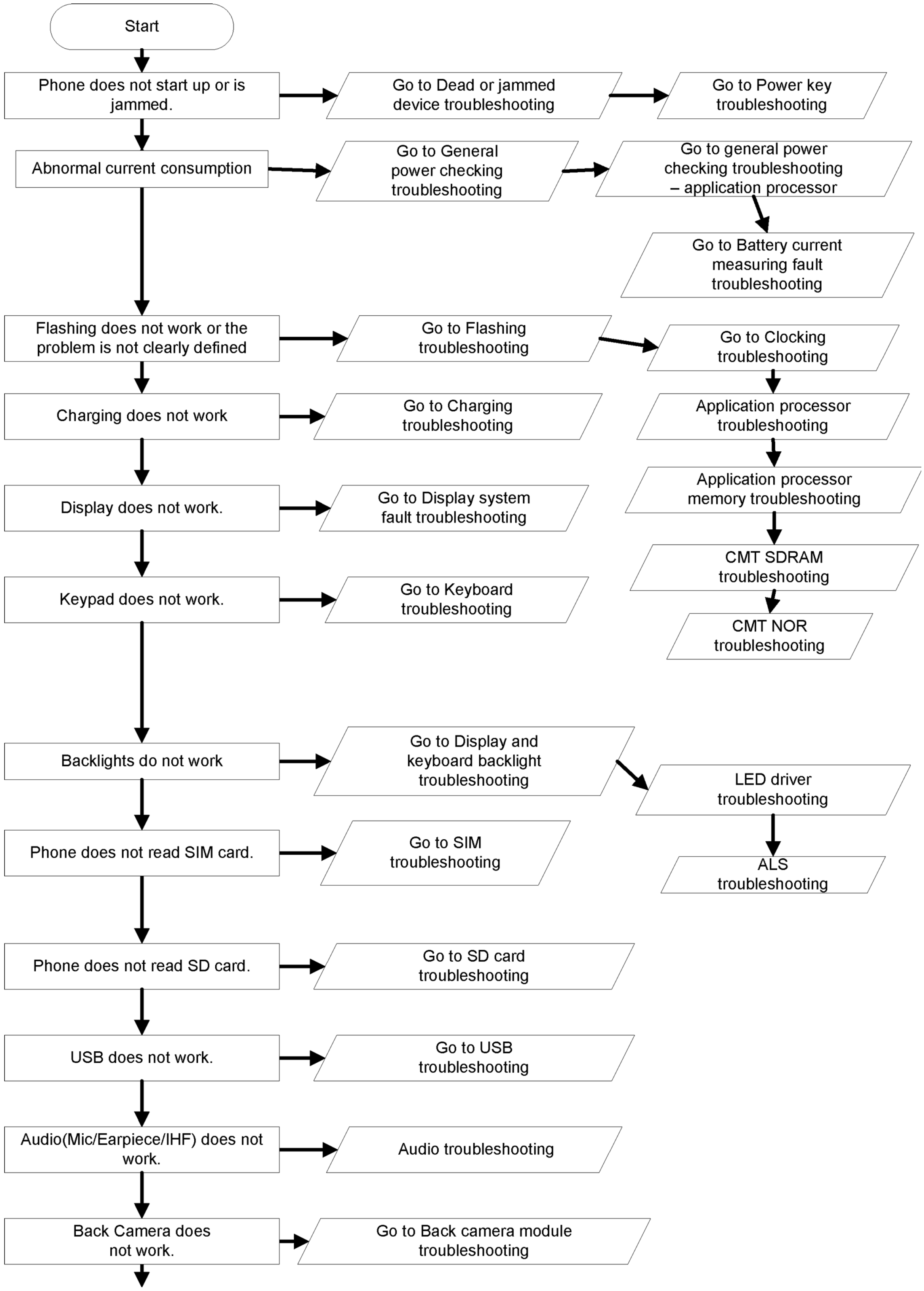
Figure 11 Single-ended output waveform of the HP_in_Ext_out loop when microphone is connected. ... 3–46

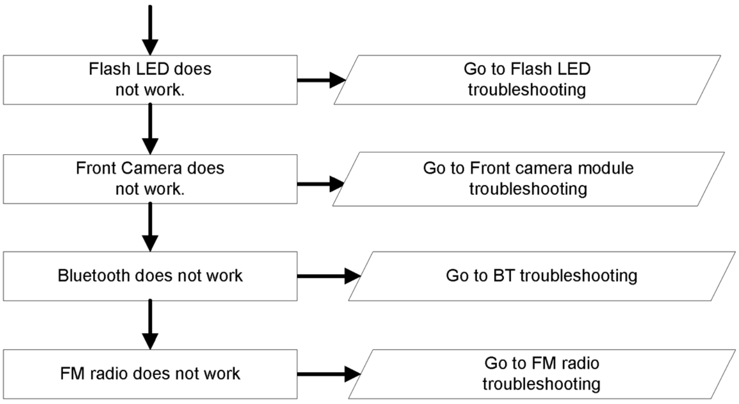
Baseband troubleshooting

Context

This section is intended to be a guide for localising and repairing electrical faults. The fault repairing is divided into troubleshooting paths. The following main troubleshooting tree describes the different baseband troubleshooting paths to be followed in fault situations.

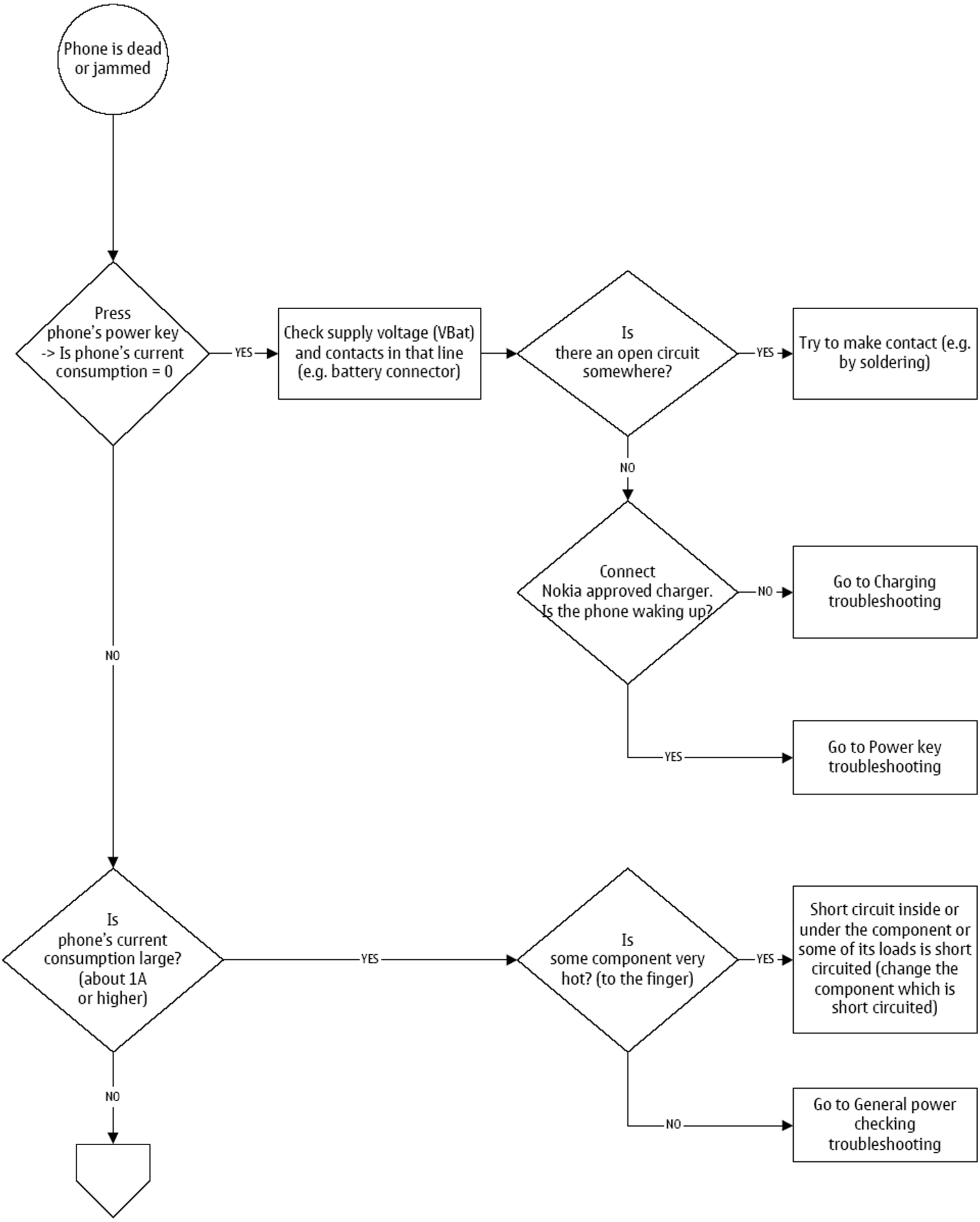
Troubleshooting flow


Start
Phone does not start up or is jammed.
Go to Dead or jammed device troubleshooting
Go to Power key troubleshooting
Abnormal current consumption
Go to General power checking troubleshooting
Go to general power checking troubleshooting – application processor
Go to Battery current measuring fault troubleshooting
Flashing does not work or the problem is not clearly defined
Go to Flashing troubleshooting
Go to Clocking troubleshooting
Charging does not work
Go to Charging troubleshooting
Application processor troubleshooting
Display does not work.
Go to Display system fault troubleshooting
Application processor memory troubleshooting
CMT SDRAM troubleshooting
Keypad does not work.
Go to Keyboard troubleshooting
CMT NOR troubleshooting
Backlights do not work
Go to Display and keyboard backlight troubleshooting
LED driver troubleshooting
Phone does not read SIM card.
Go to SIM troubleshooting
ALS troubleshooting
Phone does not read SD card.
Go to SD card troubleshooting
USB does not work.
Go to USB troubleshooting
Audio(Mic/Earpiece/IHF) does not work.
Audio troubleshooting
Back Camera does not work.
Go to Back camera module troubleshooting

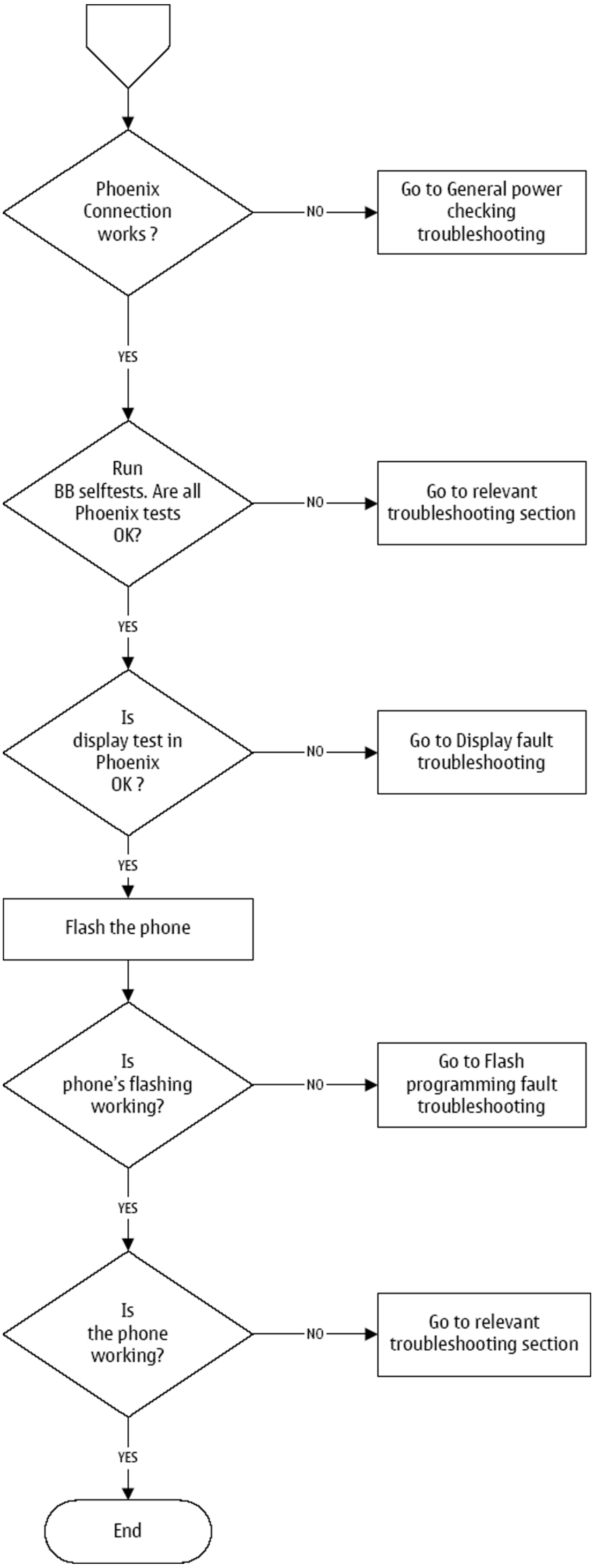

Flash LED does not work.
Go to Flash LED troubleshooting
Front Camera does not work.
Go to Front camera module troubleshooting
Bluetooth does not work
Go to BT troubleshooting
FM radio does not work
Go to FM radio troubleshooting

Dead or jammed device troubleshooting

Troubleshooting flow

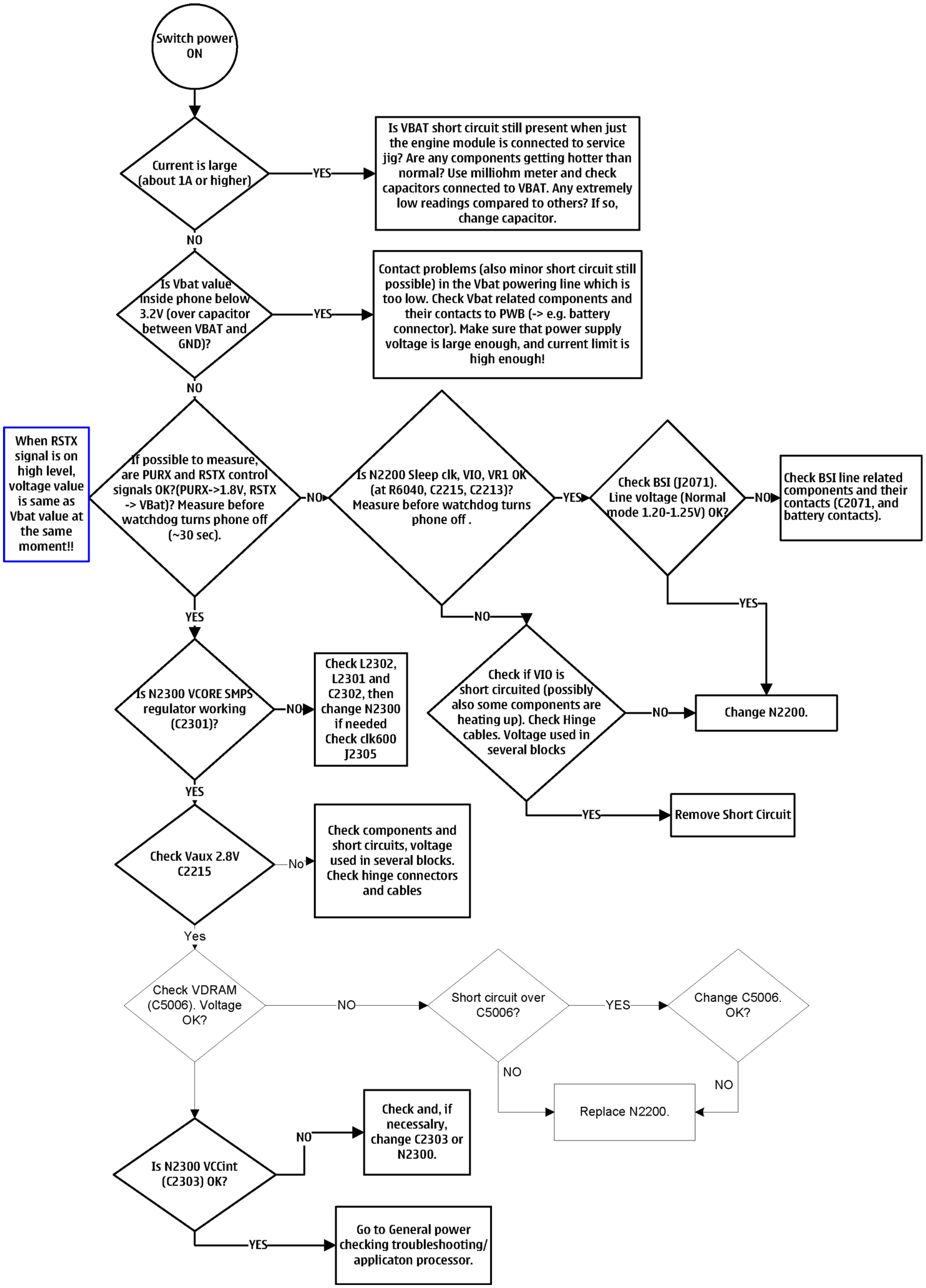

Phone is dead or jammed
Press phone's power key -> Is phone's current consumption = 0
YES
Check supply voltage (VBat) and contacts in that line (e.g. battery connector)
Is there an open circuit somewhere?
YES
Try to make contact (e.g. by soldering)
NO
Connect Nokia approved charger. Is the phone waking up?
NO
Go to Charging troubleshooting
YES
Go to Power key troubleshooting
NO
Is phone's current consumption large? (about 1A or higher)
YES
Is some component very hot? (to the finger)
YES
Short circuit inside or under the component or some of its loads is short circuited (change the component which is short circuited)
NO
Go to General power checking troubleshooting
NO

Troubleshooting flow


Phoenix Connection works ?
NO
Go to General power checking troubleshooting
YES
Run BB selftests. Are all Phoenix tests OK?
NO
Go to relevant troubleshooting section
YES
Is display test in Phoenix OK ?
NO
Go to Display fault troubleshooting
YES
Flash the phone
Is phone's flashing working?
NO
Go to Flash programming fault troubleshooting
YES
Is the phone working?
NO
Go to relevant troubleshooting section
YES
End

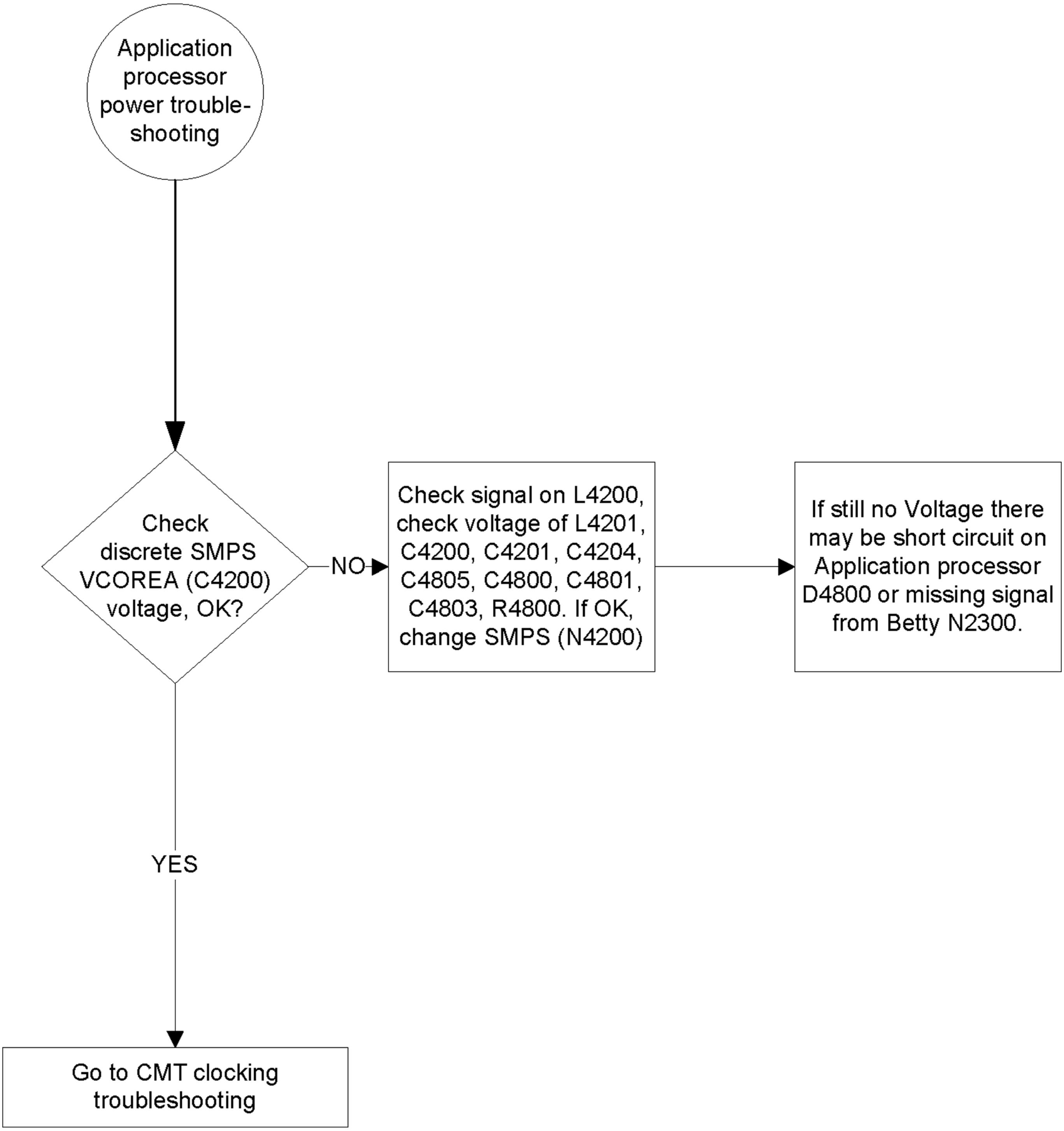
General power checking troubleshooting - CMT

Troubleshooting flow


Switch power ON
Current is large (about 1A or higher)
YES
Is VBAT short circuit still present when just the engine module is connected to service jig? Are any components getting hotter than normal? Use milliohm meter and check capacitors connected to VBAT. Any extremely low readings compared to others? If so, change capacitor.
NO
Is Vbat value inside phone below 3.2V (over capacitor between VBAT and GND)?
YES
Contact problems (also minor short circuit still possible) in the Vbat powering line which is too low. Check Vbat related components and their contacts to PWB (-> e.g. battery connector). Make sure that power supply voltage is large enough, and current limit is high enough!
NO
When RSTX signal is on high level, voltage value is same as Vbat value at the same moment!!
If possible to measure, are PURX and RSTX control signals OK?(PURX->1.8V, RSTX -> VBat)? Measure before watchdog turns phone off (~30 sec).
NO
Is N2200 Sleep clk, VIO, VR1 OK (at R6040, C2215, C2213)? Measure before watchdog turns phone off .
YES
Check BSI (J2071). Line voltage (Normal mode 1.20-1.25V) OK?
NO
Check BSI line related components and their contacts (C2071, and battery contacts).
YES
NO
YES
Is N2300 VCORE SMPS regulator working (C2301)?
NO
Check L2302, L2301 and C2302, then change N2300 if needed Check clk600 J2305
Check if VIO is short circuited (possibly also some components are heating up). Check Hinge cables. Voltage used in several blocks
NO
Change N2200.
YES
Remove Short Circuit
YES
Check Vaux 2.8V C2215
No
Check components and short circuits, voltage used in several blocks. Check hinge connectors and cables
Yes
Check VDRAM (C5006). Voltage OK?
NO
Short circuit over C5006?
YES
Change C5006. OK?
NO
NO
Replace N2200.
Is N2300 VCCint (C2303) OK?
NO
Check and, if necessalry, change C2303 or N2300.
YES
Go to General power checking troubleshooting/ applicaton processor.

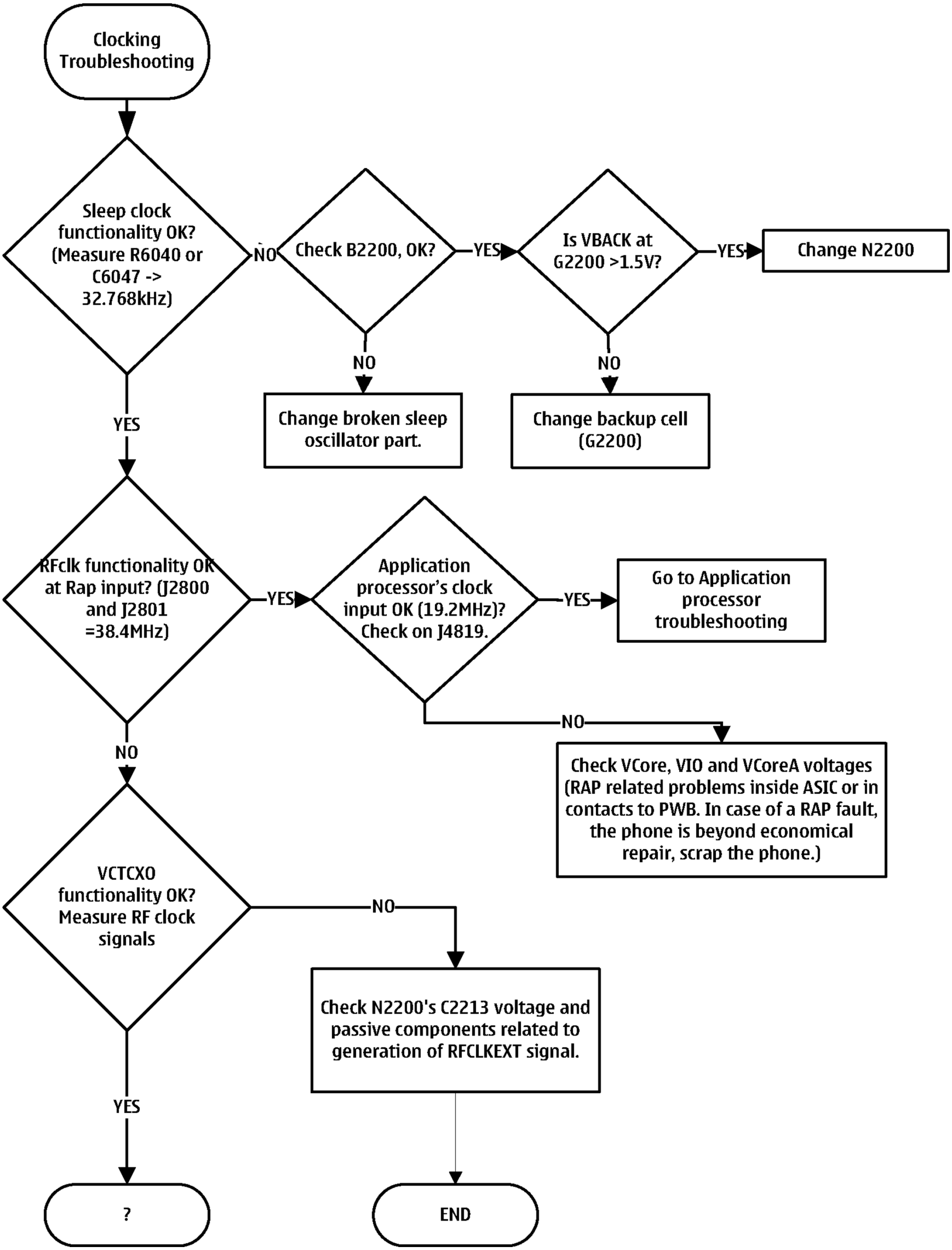
General power checking troubleshooting - application processor

Troubleshooting flow


Application processor power trouble-shooting
Check discrete SMPS VCOREA (C4200) voltage, OK?
NO
Check signal on L4200, check voltage of L4201, C4200, C4201, C4204, C4805, C4800, C4801, C4803, R4800. If OK, change SMPS (N4200)
If still no Voltage there may be short circuit on Application processor D4800 or missing signal from Betty N2300.
YES
Go to CMT clocking troubleshooting

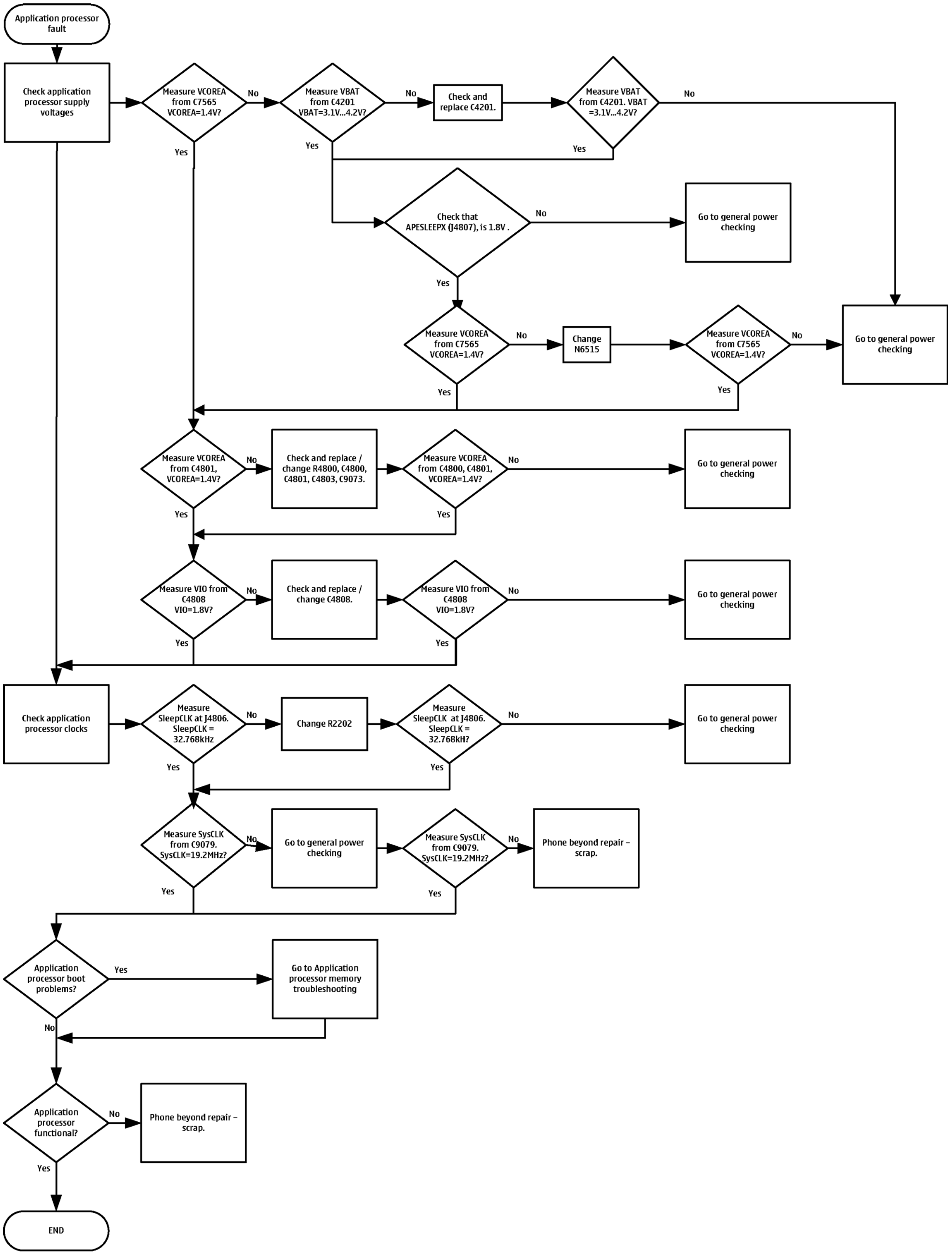
CMT clocking troubleshooting

Troubleshooting flow


Clocking Troubleshooting
Sleep clock functionality OK? (Measure R6040 or C6047 -> 32.768kHz)
NO
Check B2200, OK?
YES
Is VBACK at G2200 >1.5V?
YES
Change N2200
NO
Change broken sleep oscillator part.
NO
Change backup cell (G2200)
YES
RFclk functionality OK at Rap input? (J2800 and J2801 =38.4MHz)
YES
Application processor's clock input OK (19.2MHz)? Check on J4819.
YES
Go to Application processor troubleshooting
NO
Check VCore, VIO and VCoreA voltages (RAP related problems inside ASIC or in contacts to PWB. In case of a RAP fault, the phone is beyond economical repair, scrap the phone.)
NO
VCTCXO functionality OK? Measure RF clock signals
NO
Check N2200's C2213 voltage and passive components related to generation of RFCLKEXT signal.
YES
?
END

Application processor troubleshooting

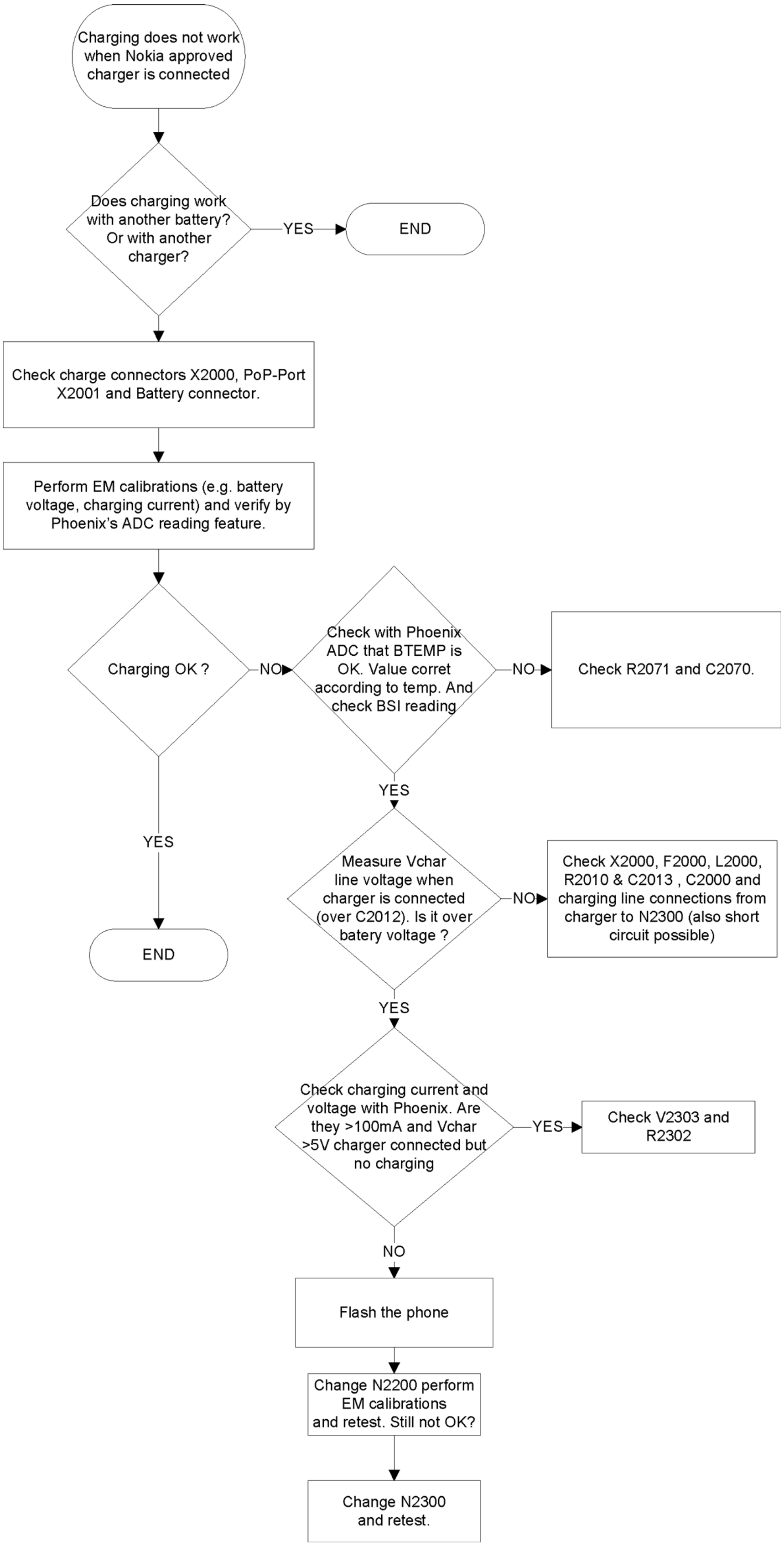
Troubleshooting flow


Application processor fault
Check application processor supply voltages
Measure VCOREA from C7565 VCOREA=1.4V?
No
Measure VBAT from C4201 VBAT=3.1V...4.2V?
No
Check and replace C4201.
Measure VBAT from C4201. VBAT =3.1V...4.2V?
No
Yes
Yes
Yes
Check that APESLEEPX (J4807), is 1.8V .
No
Go to general power checking
Yes
Measure VCOREA from C7565 VCOREA=1.4V?
No
Change N6515
Measure VCOREA from C7565 VCOREA=1.4V?
No
Go to general power checking
Yes
Yes
Measure VCOREA from C4801, VCOREA=1.4V?
No
Check and replace / change R4800, C4800, C4801, C4803, C9073.
Measure VCOREA from C4800, C4801, VCOREA=1.4V?
No
Go to general power checking
Yes
Yes
Measure VIO from C4808 VIO=1.8V?
No
Check and replace / change C4808.
Measure VIO from C4808 VIO=1.8V?
No
Go to general power checking
Yes
Yes
Check application processor clocks
Measure SleepCLK at J4806. SleepCLK = 32.768kHz
No
Change R2202
Measure SleepCLK at J4806. SleepCLK = 32.768kH?
No
Go to general power checking
Yes
Yes
Measure SysCLK from C9079. SysCLK=19.2MHz?
No
Go to general power checking
Measure SysCLK from C9079. SysCLK=19.2MHz?
No
Phone beyond repair – scrap.
Yes
Yes
Application processor boot problems?
Yes
Go to Application processor memory troubleshooting
No
Application processor functional?
No
Phone beyond repair – scrap.
Yes
END

Note: It is not possble to change the application processor. In this case, the PWB is beyond economical repair.

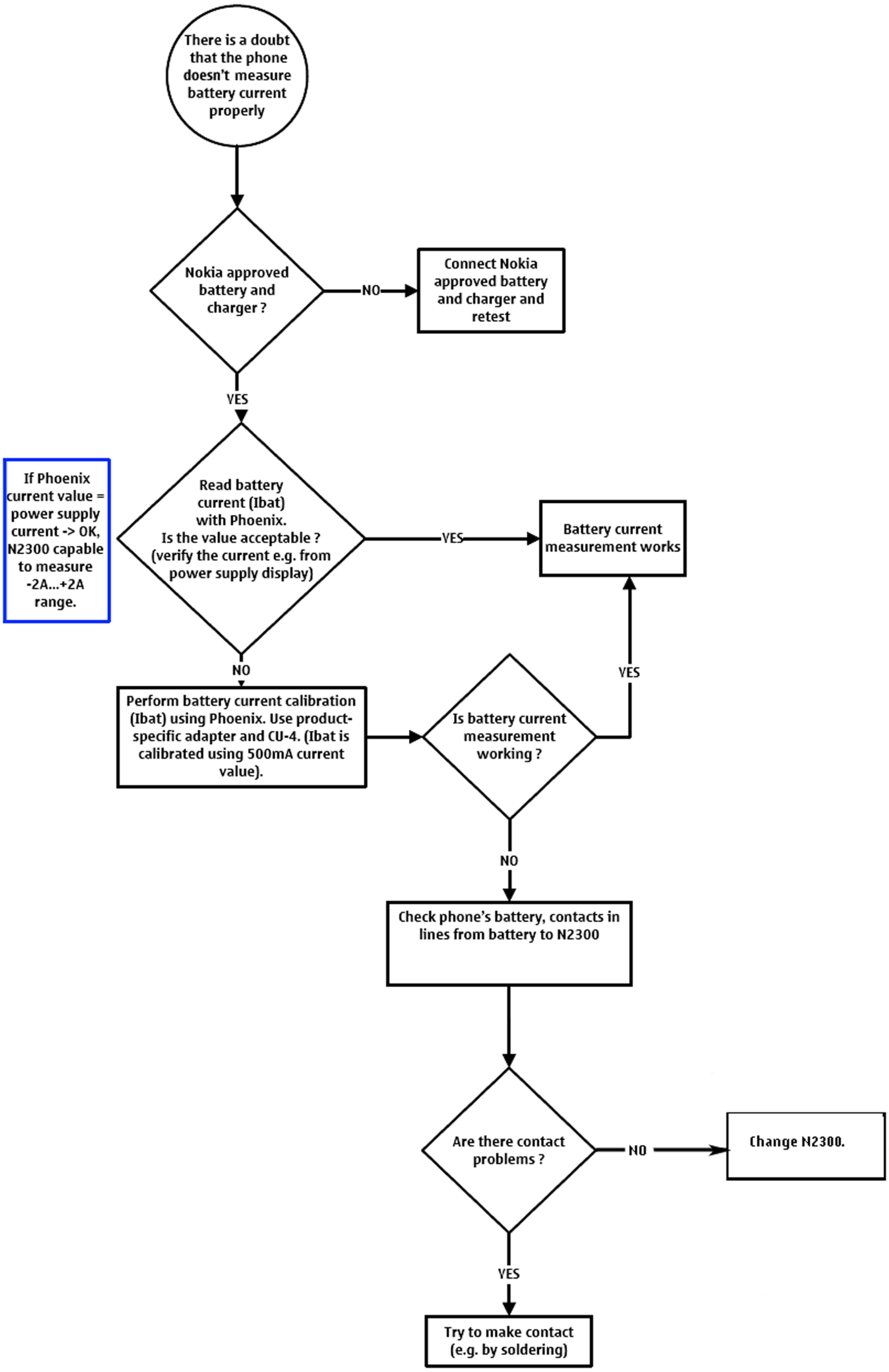
Charging troubleshooting

Troubleshooting flow


Charging does not work when Nokia approved charger is connected
Does charging work with another battery? Or with another charger?
YES
END
Check charge connectors X2000, PoP-Port X2001 and Battery connector.
Perform EM calibrations (e.g. battery voltage, charging current) and verify by Phoenix's ADC reading feature.
Charging OK ?
NO
Check with Phoenix ADC that BTEMP is OK. Value corret according to temp. And check BSI reading
NO
Check R2071 and C2070.
YES
YES
END
Measure Vchar line voltage when charger is connected (over C2012). Is it over batery voltage ?
NO
Check X2000, F2000, L2000, R2010 & C2013 , C2000 and charging line connections from charger to N2300 (also short circuit possible)
YES
Check charging current and voltage with Phoenix. Are they >100mA and Vchar >5V charger connected but no charging
YES
Check V2303 and R2302
NO
Flash the phone
Change N2200 perform EM calibrations and retest. Still not OK?
Change N2300 and retest.

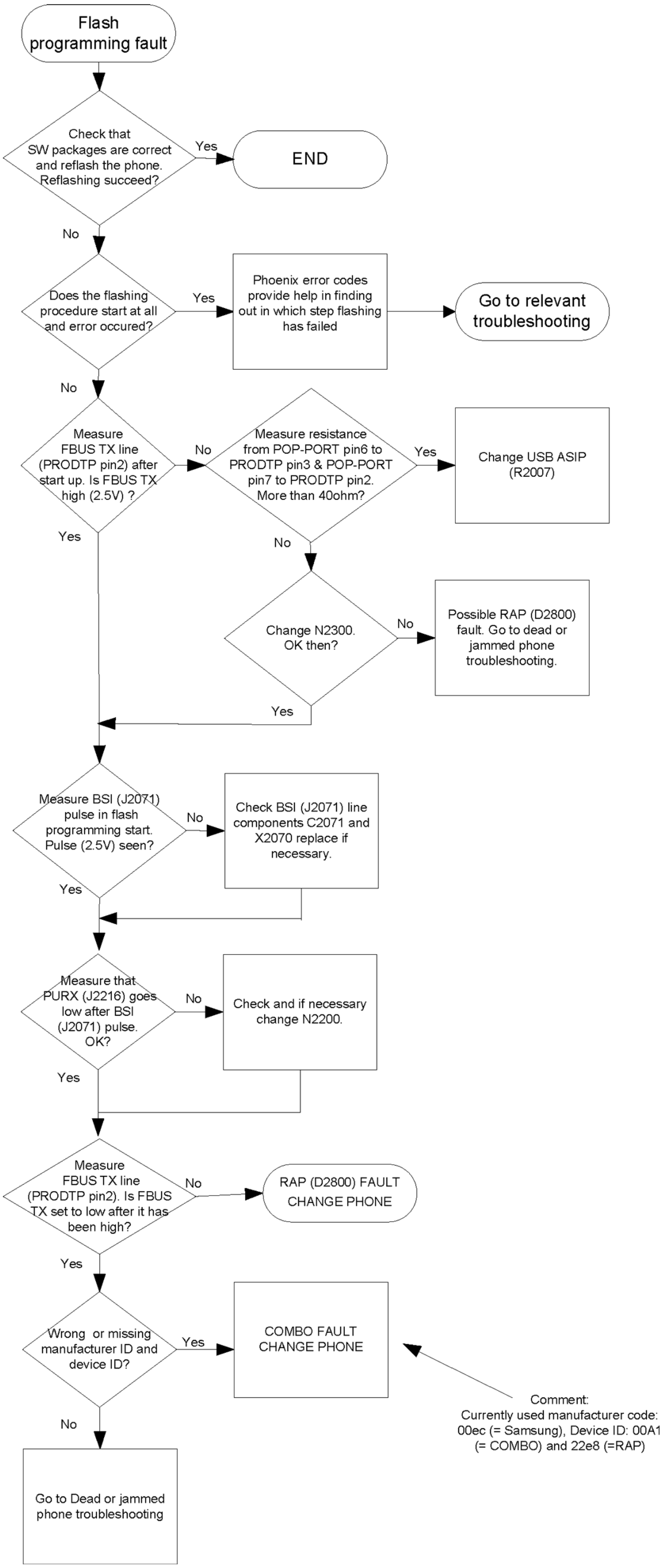
Battery current measuring fault troubleshooting

Troubleshooting flow


There is a doubt that the phone doesn't measure battery current properly
Nokia approved battery and charger ?
NO
Connect Nokia approved battery and charger and retest
YES
If Phoenix current value = power supply current -> OK, N2300 capable to measure -2A...+2A range.
Read battery current (Ibat) with Phoenix. Is the value acceptable ? (verify the current e.g. from power supply display)
YES
Battery current measurement works
NO
Perform battery current calibration (Ibat) using Phoenix. Use product-specific adapter and CU-4. (Ibat is calibrated using 500mA current value).
Is battery current measurement working ?
YES
NO
Check phone's battery, contacts in lines from battery to N2300
Are there contact problems ?
NO
Change N2300.
YES
Try to make contact (e.g. by soldering)

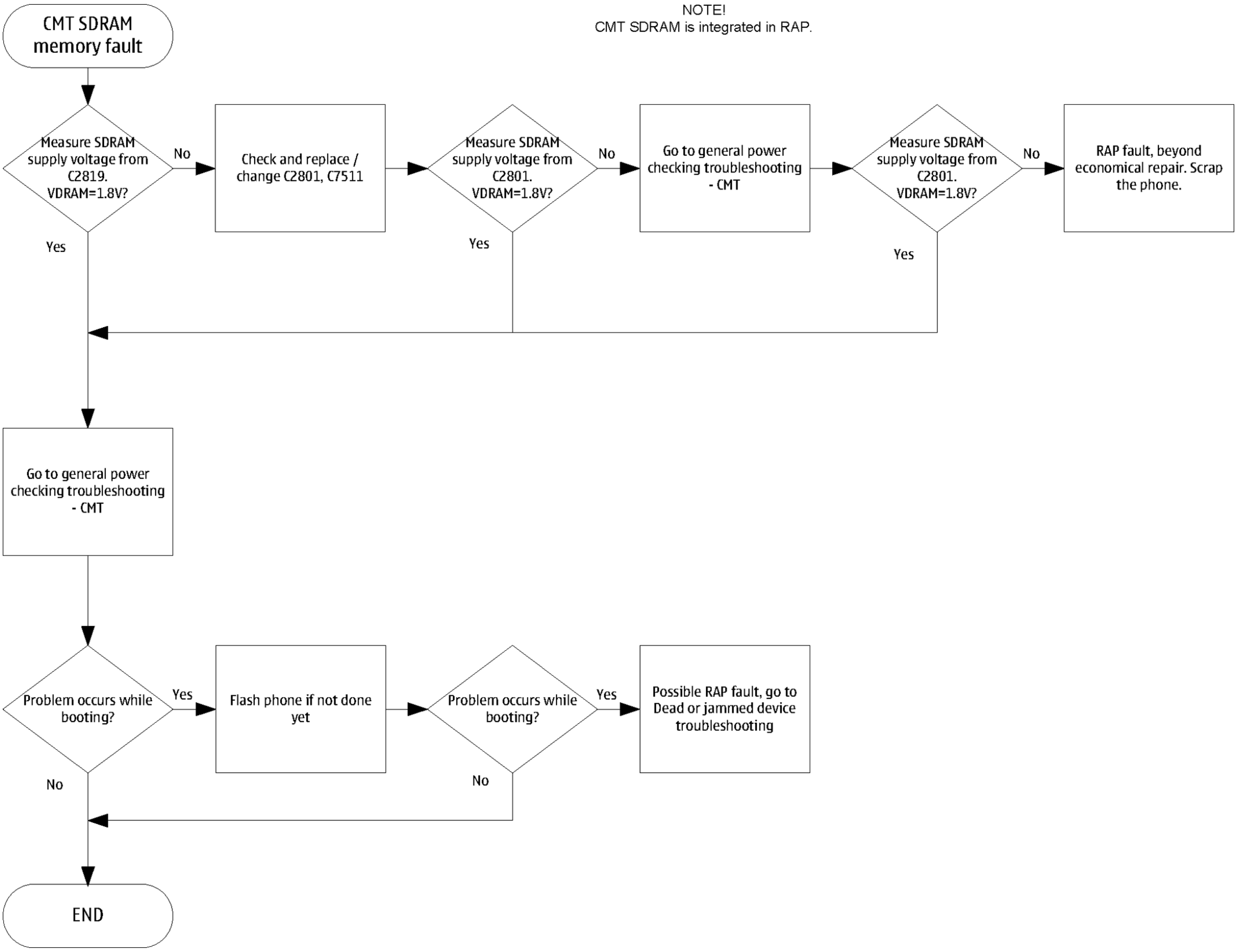
Flash fault troubleshooting

Troubleshooting flow


Flash programming fault
Check that SW packages are correct and reflash the phone. Reflashing succeed?
Yes
END
No
Does the flashing procedure start at all and error occured?
Yes
Phoenix error codes provide help in finding out in which step flashing has failed
Go to relevant troubleshooting
No
Measure FBUS TX line (PRODTP pin2) after start up. Is FBUS TX high (2.5V) ?
No
Measure resistance from POP-PORT pin6 to PRODTP pin3 & POP-PORT pin7 to PRODTP pin2. More than 40ohm?
Yes
Change USB ASIP (R2007)
No
Change N2300. OK then?
No
Possible RAP (D2800) fault. Go to dead or jammed phone troubleshooting.
Yes
Yes
Measure BSI (J2071) pulse in flash programming start. Pulse (2.5V) seen?
No
Check BSI (J2071) line components C2071 and X2070 replace if necessary.
Yes
Measure that PURX (J2216) goes low after BSI (J2071) pulse. OK?
No
Check and if necessary change N2200.
Yes
Measure FBUS TX line (PRODTP pin2). Is FBUS TX set to low after it has been high?
No
RAP (D2800) FAULT CHANGE PHONE
Yes
Wrong or missing manufacturer ID and device ID?
Yes
COMBO FAULT CHANGE PHONE
Comment: Currently used manufacturer code: 00ec (= Samsung), Device ID: 00A1 (= COMBO) and 22e8 (=RAP)
No
Go to Dead or jammed phone troubleshooting

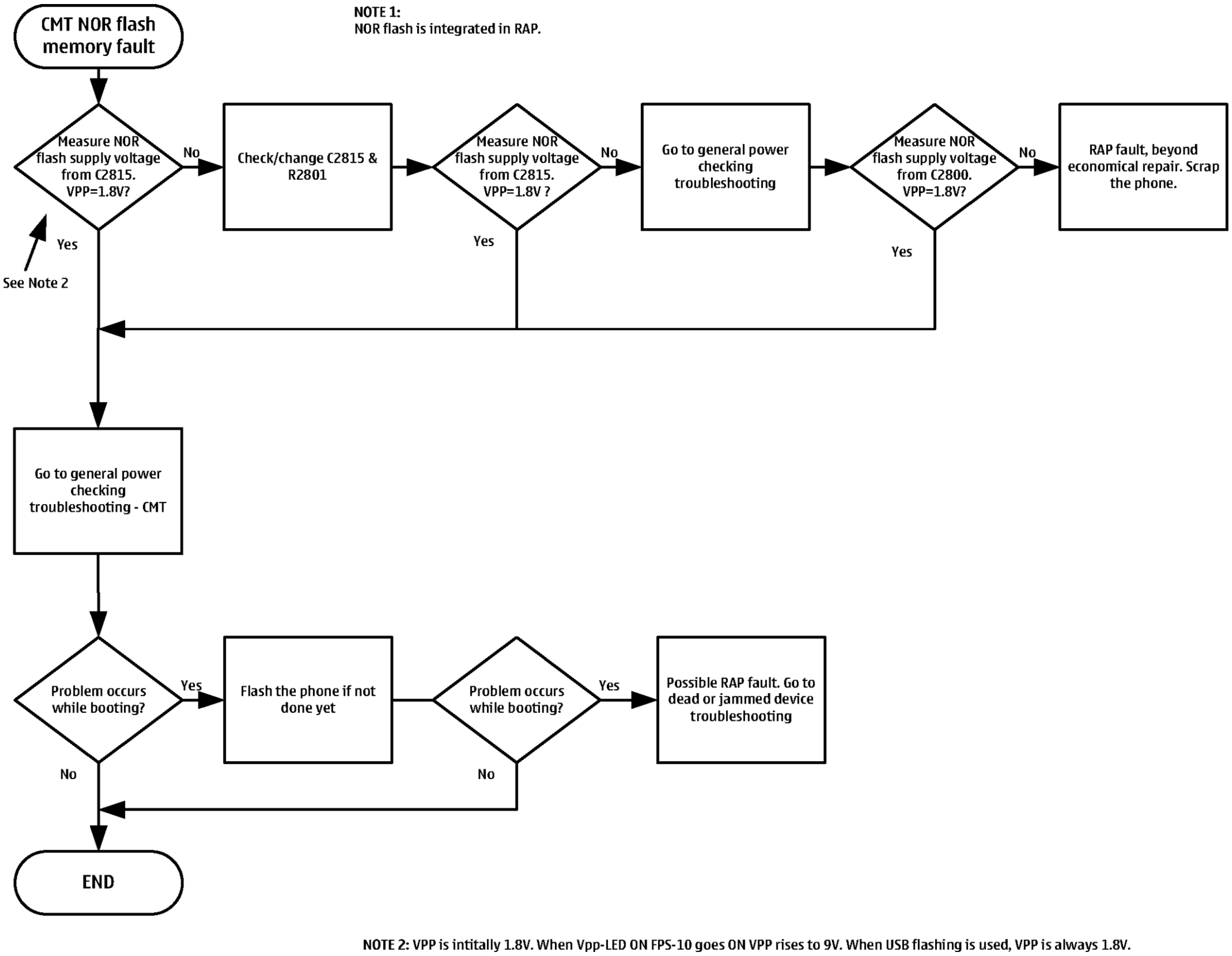
CMT SDRAM memory troubleshooting

Troubleshooting flow


NOTE!
CMT SDRAM is integrated in RAP.
CMT SDRAM memory fault
Measure SDRAM supply voltage from C2819. VDRAM=1.8V?
No
Check and replace / change C2801, C7511
Measure SDRAM supply voltage from C2801. VDRAM=1.8V?
No
Go to general power checking troubleshooting - CMT
Measure SDRAM supply voltage from C2801. VDRAM=1.8V?
No
RAP fault, beyond economical repair. Scrap the phone.
Yes
Yes
Yes
Go to general power checking troubleshooting - CMT
Problem occurs while booting?
Yes
Flash phone if not done yet
Problem occurs while booting?
Yes
Possible RAP fault, go to Dead or jammed device troubleshooting
No
No
END

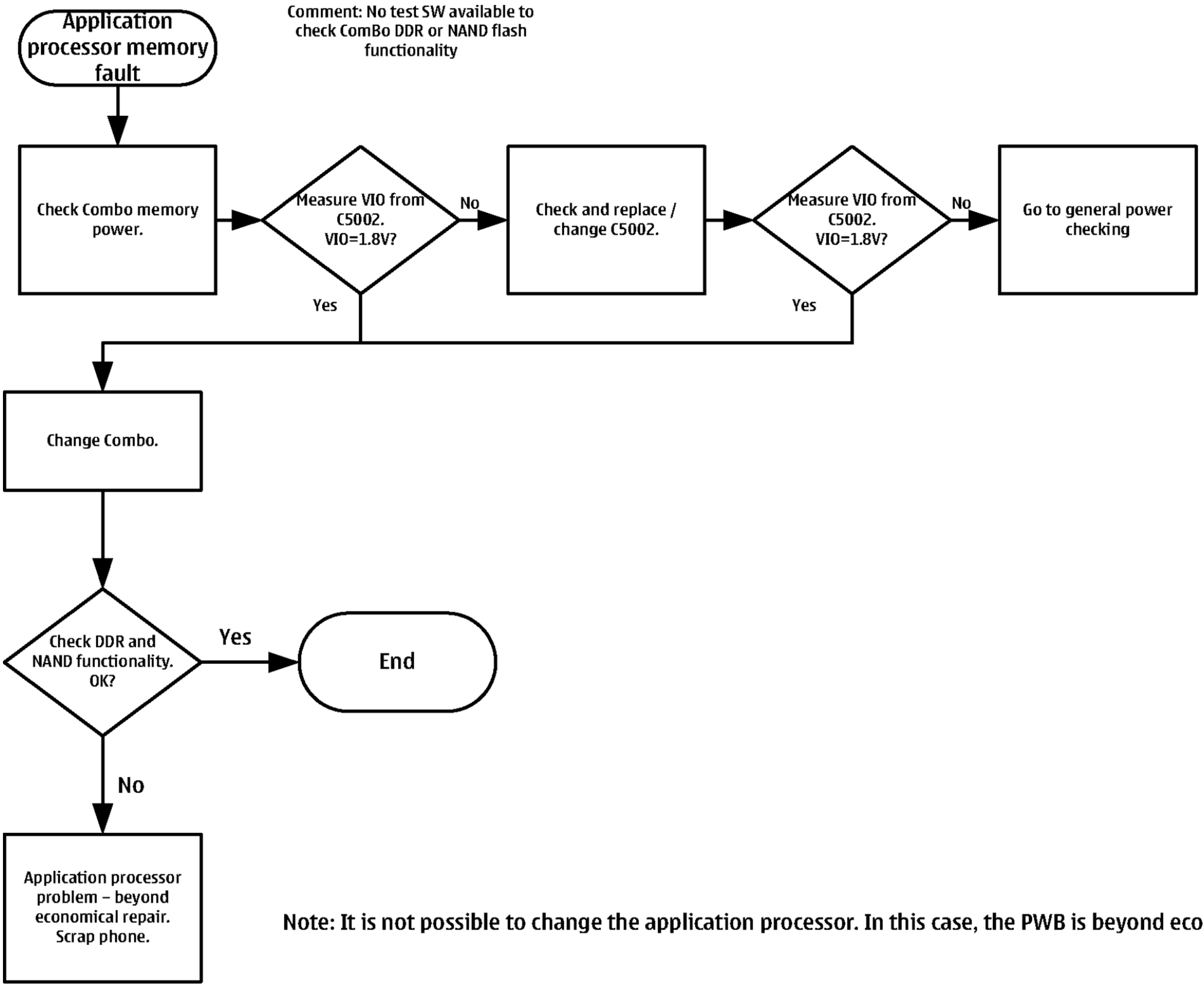
CMT NOR flash fault troubleshooting

Troubleshooting flow


CMT NOR flash memory fault
NOTE 1:
NOR flash is integrated in RAP.
Measure NOR flash supply voltage from C2815. VPP=1.8V?
No
Check/change C2815 & R2801
Measure NOR flash supply voltage from C2815. VPP=1.8V ?
No
Go to general power checking troubleshooting
Measure NOR flash supply voltage from C2800. VPP=1.8V?
No
RAP fault, beyond economical repair. Scrap the phone.
Yes
See Note 2
Yes
Yes
Go to general power checking troubleshooting - CMT
Problem occurs while booting?
Yes
Flash the phone if not done yet
Problem occurs while booting?
Yes
Possible RAP fault. Go to dead or jammed device troubleshooting
No
No
END
NOTE 2: VPP is intitally 1.8V. When Vpp-LED ON FPS-10 goes ON VPP rises to 9V. When USB flashing is used, VPP is always 1.8V.

Application processor memory troubleshooting

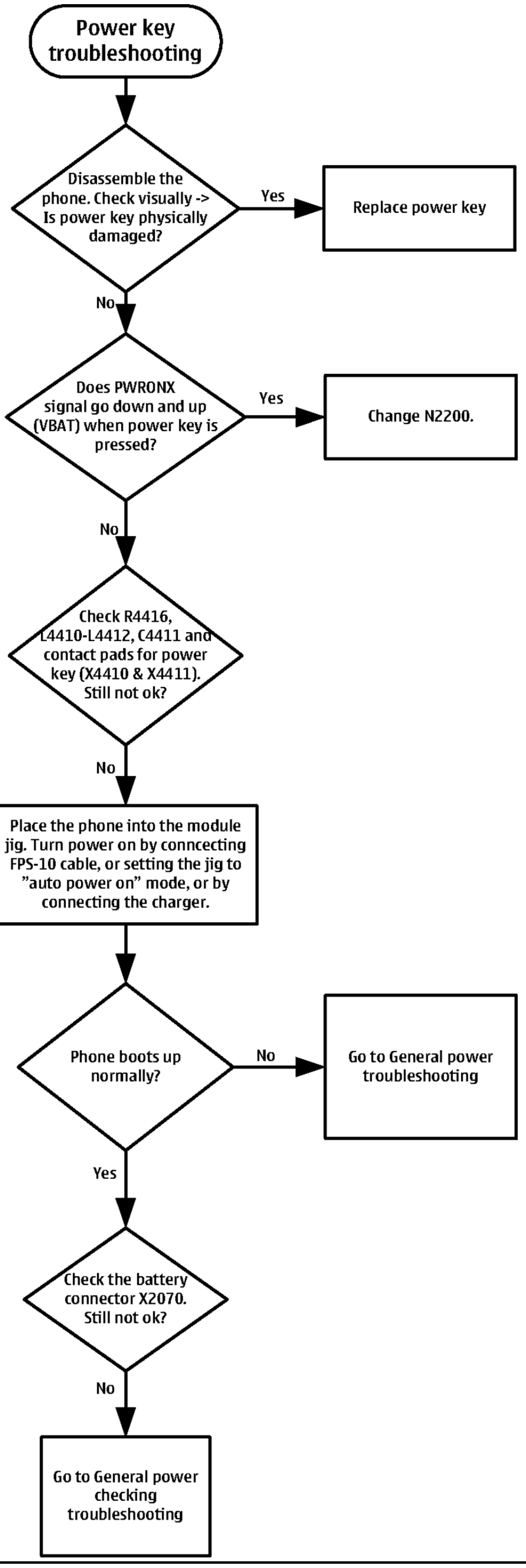
Troubleshooting flow


Application processor memory fault
Comment: No test SW available to check ComBo DDR or NAND flash functionality
Check Combo memory power.
Measure VIO from C5002. VIO=1.8V?
No
Check and replace / change C5002.
Measure VIO from C5002. VIO=1.8V?
No
Go to general power checking
Yes
Yes
Change Combo.
Check DDR and NAND functionality. OK?
Yes
End
No
Application processor problem – beyond economical repair. Scrap phone.

Note: It is not possible to change the application processor. In this case, the PWB is beyond economical repair.

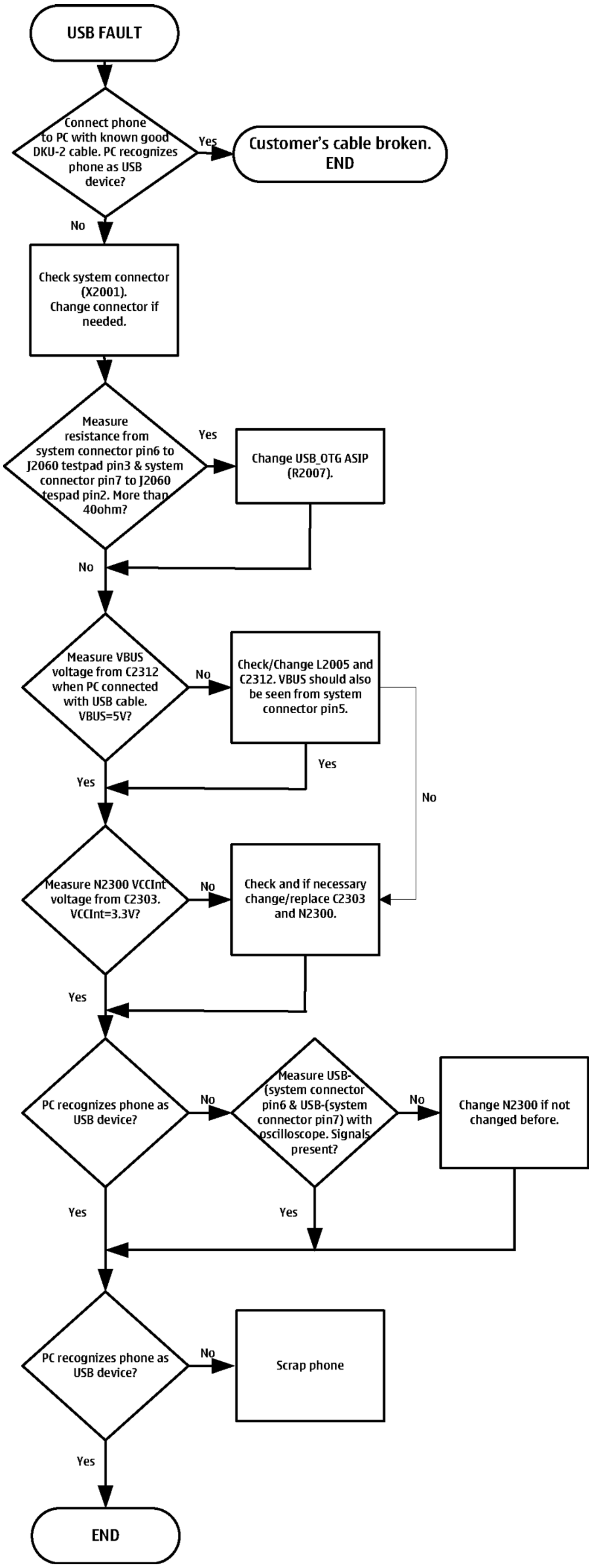
Power key troubleshooting

Troubleshooting flow


Power key troubleshooting
Disassemble the phone. Check visually -> Is power key physically damaged?
Yes
Replace power key
No
Does PWRONX signal go down and up (VBAT) when power key is pressed?
Yes
Change N2200.
No
Check R4416, L4410-L4412, C4411 and contact pads for power key (X4410 & X4411). Still not ok?
No
Place the phone into the module jig. Turn power on by conncecting FPS-10 cable, or setting the jig to "auto power on" mode, or by connecting the charger.
Phone boots up normally?
No
Go to General power troubleshooting
Yes
Check the battery connector X2070. Still not ok?
No
Go to General power checking troubleshooting

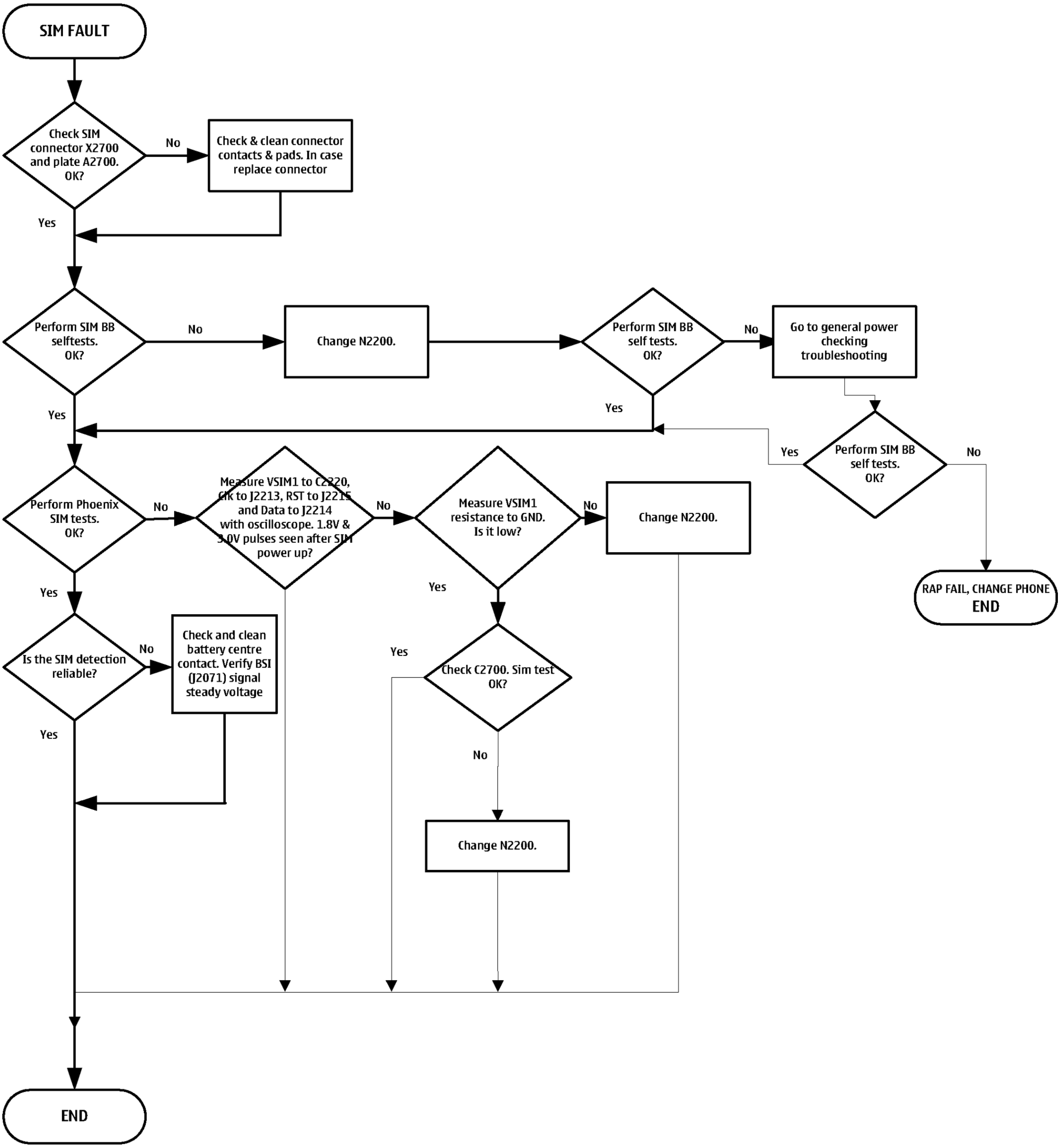
USB interface troubleshooting

Troubleshooting flow


USB FAULT
Connect phone to PC with known good DKU-2 cable. PC recognizes phone as USB device?
Yes
Customer's cable broken. END
No
Check system connector (X2001). Change connector if needed.
Measure resistance from system connector pin6 to J2060 testpad pin3 & system connector pin7 to J2060 tespad pin2. More than 40ohm?
Yes
Change USB_OTG ASIP (R2007).
No
Measure VBUS voltage from C2312 when PC connected with USB cable. VBUS=5V?
No
Check/Change L2005 and C2312. VBUS should also be seen from system connector pin5.
Yes
Yes
No
Measure N2300 VCCInt voltage from C2303. VCCInt=3.3V?
No
Check and if necessary change/replace C2303 and N2300.
Yes
PC recognizes phone as USB device?
No
Measure USB- (system connector pin6 & USB-(system connector pin7) with oscilloscope. Signals present?
No
Change N2300 if not changed before.
Yes
Yes
PC recognizes phone as USB device?
No
Scrap phone
Yes
END

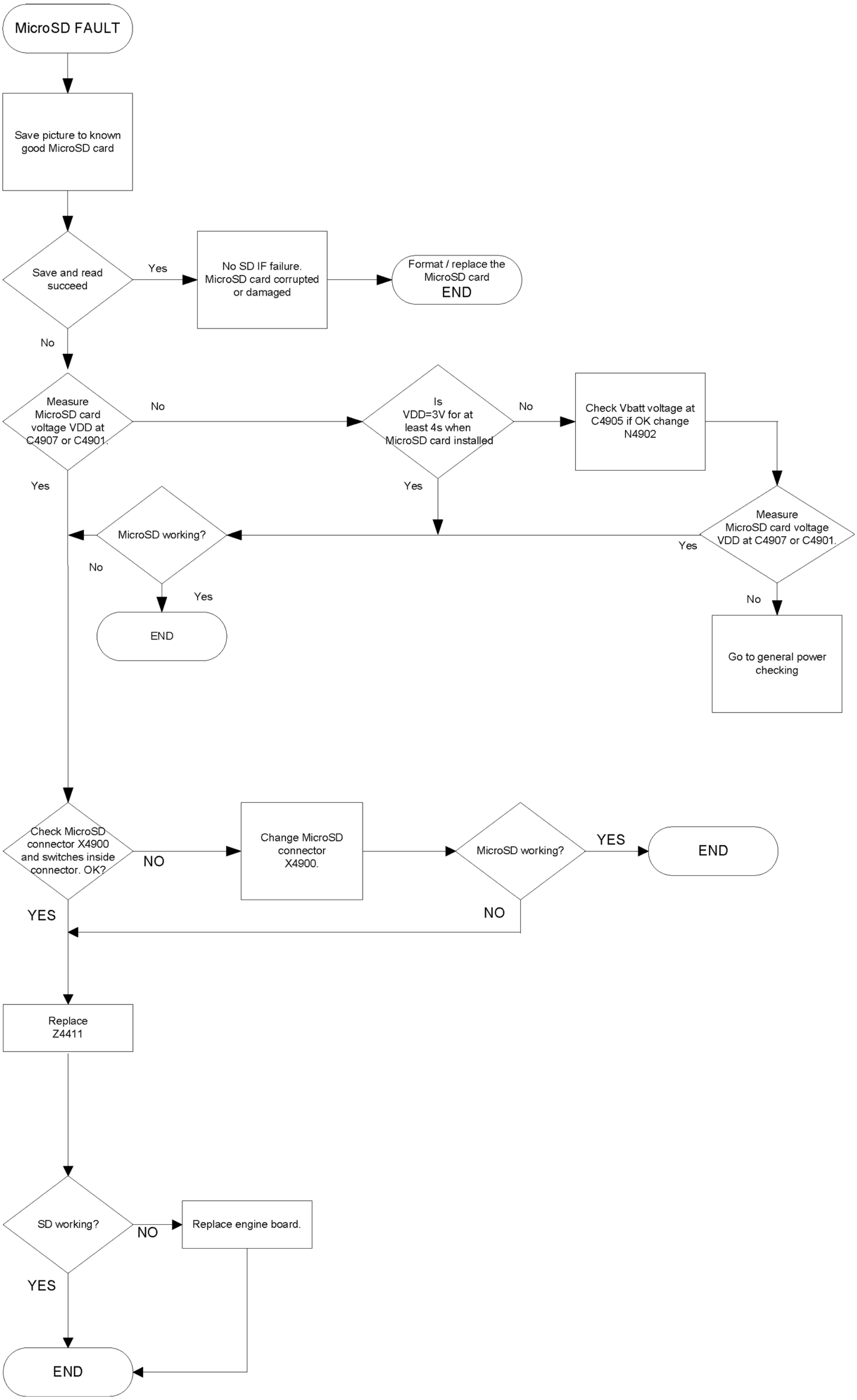
SIM card troubleshooting

Troubleshooting flow


SIM FAULT
Check SIM connector X2700 and plate A2700. OK?
No
Check & clean connector contacts & pads. In case replace connector
Yes
Perform SIM BB selftests. OK?
No
Change N2200.
Perform SIM BB self tests. OK?
No
Go to general power checking troubleshooting
Yes
Yes
Perform SIM BB self tests. OK?
Yes
No
RAP FAIL, CHANGE PHONE
END
Perform Phoenix SIM tests. OK?
No
Measure VSIM1 to C2220, Clk to J2213, RST to J2215 and Data to J2214 with oscilloscope. 1.8V & 3.0V pulses seen after SIM power up?
No
Measure VSIM1 resistance to GND. Is it low?
No
Change N2200.
Yes
Yes
Is the SIM detection reliable?
No
Check and clean battery centre contact. Verify BSI (J2071) signal steady voltage
Yes
Check C2700. Sim test OK?
Yes
No
Change N2200.
Yes
END

MicroSD card troubleshooting

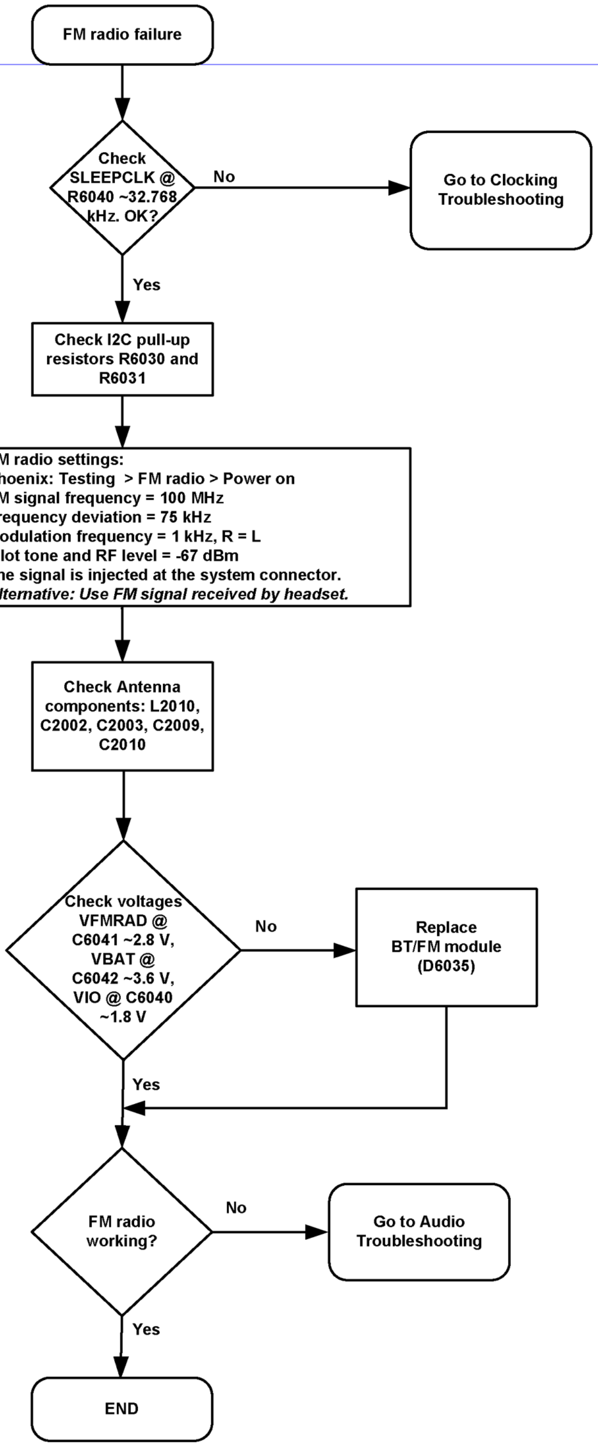
Troubleshooting flow


All measurements provide that the SD is initializing or some operation is being tried to perform. SD power is cut after 4s idle time

MicroSD FAULT
Save picture to known good MicroSD card
Save and read succeed
Yes
No SD IF failure. MicroSD card corrupted or damaged
Format / replace the MicroSD card END
No
Measure MicroSD card voltage VDD at C4907 or C4901.
No
Is VDD=3V for at least 4s when MicroSD card installed
No
Check Vbatt voltage at C4905 if OK change N4902
Yes
Yes
MicroSD working?
No
Yes
END
Measure MicroSD card voltage VDD at C4907 or C4901.
Yes
No
Go to general power checking
Check MicroSD connector X4900 and switches inside connector. OK?
NO
Change MicroSD connector X4900.
MicroSD working?
YES
END
NO
YES
Replace Z4411
SD working?
NO
Replace engine board.
YES
END

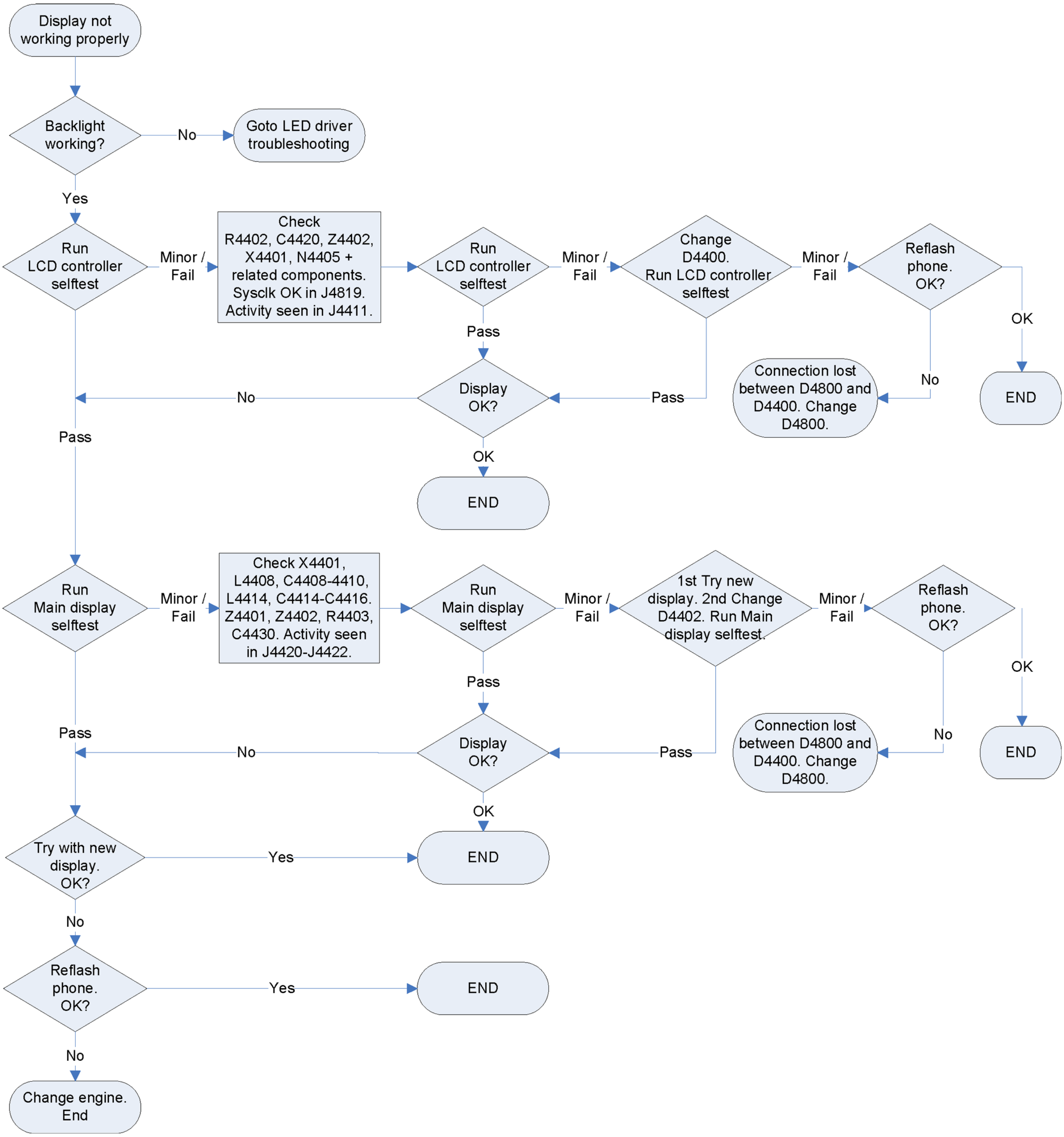
FM radio troubleshooting

Troubleshooting flow


FM radio failure
Check SLEEPCLK @ R6040 ~32.768 kHz. OK?
No
Go to Clocking Troubleshooting
Yes
Check I2C pull-up resistors R6030 and R6031
FM radio settings:
Phoenix: Testing > FM radio > Power on
FM signal frequency = 100 MHz
Frequency deviation = 75 kHz
Modulation frequency = 1 kHz, R = L
pilot tone and RF level = -67 dBm
The signal is injected at the system connector.
Alternative: Use FM signal received by headset.
Check Antenna components: L2010, C2002, C2003, C2009, C2010
Check voltages VFMRAD @ C6041 ~2.8 V, VBAT @ C6042 ~3.6 V, VIO @ C6040 ~1.8 V
No
Replace BT/FM module (D6035)
Yes
FM radio working?
No
Go to Audio Troubleshooting
Yes
END

Display fault troubleshooting

Troubleshooting flow


Display not working properly
Backlight working?
No
Goto LED driver troubleshooting
Yes
Run LCD controller selftest
Minor / Fail
Check R4402, C4420, Z4402, X4401, N4405 + related components. Sysclk OK in J4819. Activity seen in J4411.
Run LCD controller selftest
Minor / Fail
Change D4400. Run LCD controller selftest
Minor / Fail
Reflash phone. OK?
OK
END
No
Connection lost between D4800 and D4400. Change D4800.
Pass
Pass
Display OK?
No
OK
END
Pass
Run Main display selftest
Minor / Fail
Check X4401, L4408, C4408-4410, L4414, C4414-C4416. Z4401, Z4402, R4403, C4430. Activity seen in J4420-J4422.
Run Main display selftest
Minor / Fail
1st Try new display. 2nd Change D4402. Run Main display selftest.
Minor / Fail
Reflash phone. OK?
OK
END
No
Connection lost between D4800 and D4400. Change D4800.
Pass
Pass
Display OK?
No
OK
END
Pass
Try with new display. OK?
Yes
END
No
Reflash phone. OK?
Yes
END
No
Change engine. End

Keyboard troubleshooting

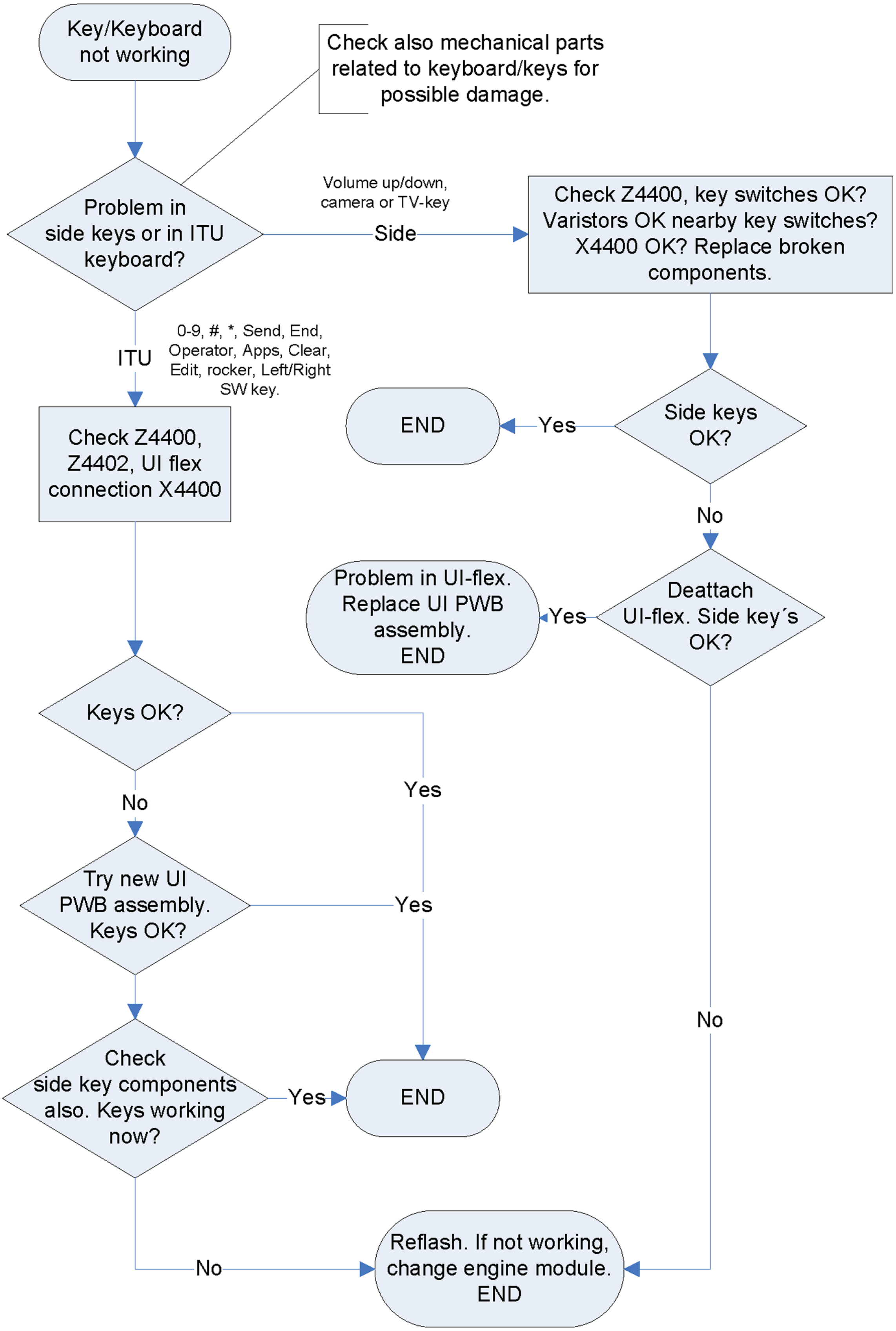
Context

There are two possible failure modes in the keyboard module:

- One or more keys can be stuck, so that the key does not react when a keydome is pressed. This kind of failure is caused by mechanical reasons (dirt, corrosion).
- Malfunction of several keys at the same time; this happens when one or more rows or columns are failing (shortcut or open connection). For a more detailed description of the keyboard and keymatrix, see section **Keyboard**.

If the failure mode is not clear, start with the **Keyboard Test** in *Phoenix*.

Troubleshooting flow


Key/Keyboard not working
Check also mechanical parts related to keyboard/keys for possible damage.
Problem in side keys or in ITU keyboard?
Volume up/down, camera or TV-key
Side
Check Z4400, key switches OK? Varistors OK nearby key switches? X4400 OK? Replace broken components.
ITU
0-9, #, *, Send, End, Operator, Apps, Clear, Edit, rocker, Left/Right SW key.
Check Z4400, Z4402, UI flex connection X4400
END
Yes
Side keys OK?
No
Problem in UI-flex. Replace UI PWB assembly. END
Yes
Deattach UI-flex. Side key´s OK?
Keys OK?
Yes
No
Try new UI PWB assembly. Keys OK?
Yes
No
Check side key components also. Keys working now?
Yes
END
No
Reflash. If not working, change engine module. END

Certificate restoring for BB5 products

Context

This procedure is performed when the device certificate is corrupted for some reason.

All tunings (RF & Baseband, UI) must be done after performing the certificate restoring procedure.

The procedure for certificate restoring is the following:

- Flash the phone with the latest available software using FPS-8 or FPS-10.

  Note: USB flashing does not work for a dead BB5 phone.
- Create a request file.
- Send the file to Nokia by e-mail. Use the following addresses depending on your location:
  - APAC: sydney.service@nokia.com
  - CHINA: repair.ams@nokia.com
  - E&A: salo.repair@nokia.com
  - AMERICAS: fls1.usa@nokia.com
- When you receive a reply from Nokia, carry out certificate restoring.
- Tune the phone completely.

  Note: SX-4 smart card is needed.
- If the phone resets after certificate restoring, reflash the phone again.

Required equipment and setup:

- *Phoenix* service software v 2004.39.7.70 or newer.
- The latest phone model specific *Phoenix* data package.
- PKD-1 dongle
- SX-4 smart card (Enables BB5 testing and tuning features)
- External smart card reader

  Note: The smart card reader is only needed when FPS-8 is used. FPS-10 has an integrated smart card reader.
- Activated FPS-8 flash prommer **OR** FPS-10 flash prommer
- Flash update package 03.18.004 or newer for FPS-8 or FPS-10 flash prommers
- CU-4 control unit
- USB cable from PC USB Port to CU-4 control unit
- Phone model specific adapter for CU-4 control unit
- PCS-1 cable to power CU-4 from external power supply
- XCS-4 modular cable between flash prommer and CU-4

  Note: CU-4 must be supplied with +12 V from an external power supply in all steps of certificate restoring.

Steps

1. Program the phone software.

   i Start *Phoenix* and login. Make sure the connection has been managed correctly for FPS-8 or FPS-10.

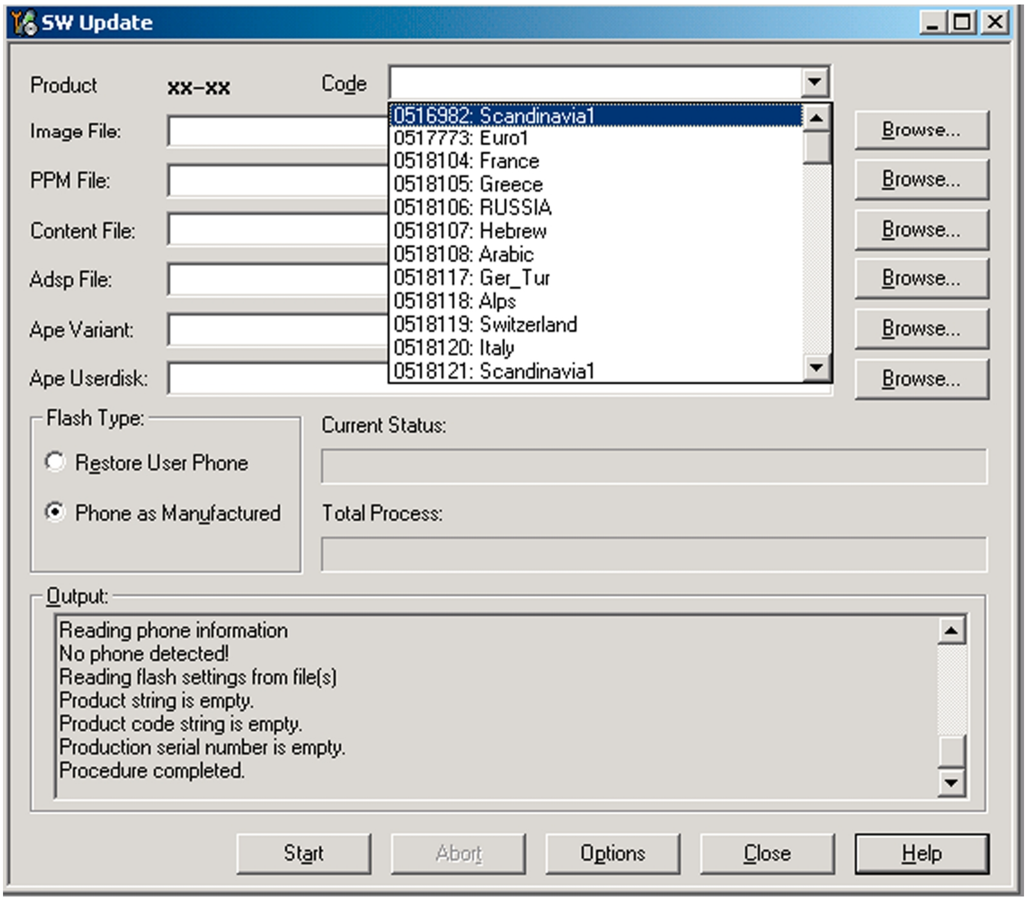
   ii Update the phone MCU software to the latest available version.

   If the new flash is empty and the phone cannot communicate with *Phoenix*, reflash the phone.

iii Choose the product manually from **File→Open Product**, and click **OK**.

Wait for the phone type designator (e.g. “RM-1”) to be displayed in the status bar.

iv Go to **Flashing→SW Update** and wait until *Phoenix* reads the product data as shown in the following picture.


SW Update
Code
Image File:
PPM File:
Content File:
Adsp File:
Ape Variant:
Ape Userdisk:
0516982: Scandinavia1
0517773: Euro1
0518104: France
0518105: Greece
0518106: RUSSIA
0518107: Hebrew
0518108: Arabic
0518117: Ger_Tur
0518118: Alps
0518119: Switzerland
0518120: Italy
0518121: Scandinavia1
Browse...
Browse...
Browse...
Browse...
Browse...
Browse...
Current Status:
Total Process:
Output:
Start
Abort
Options
Close
Help

Product xx-xx

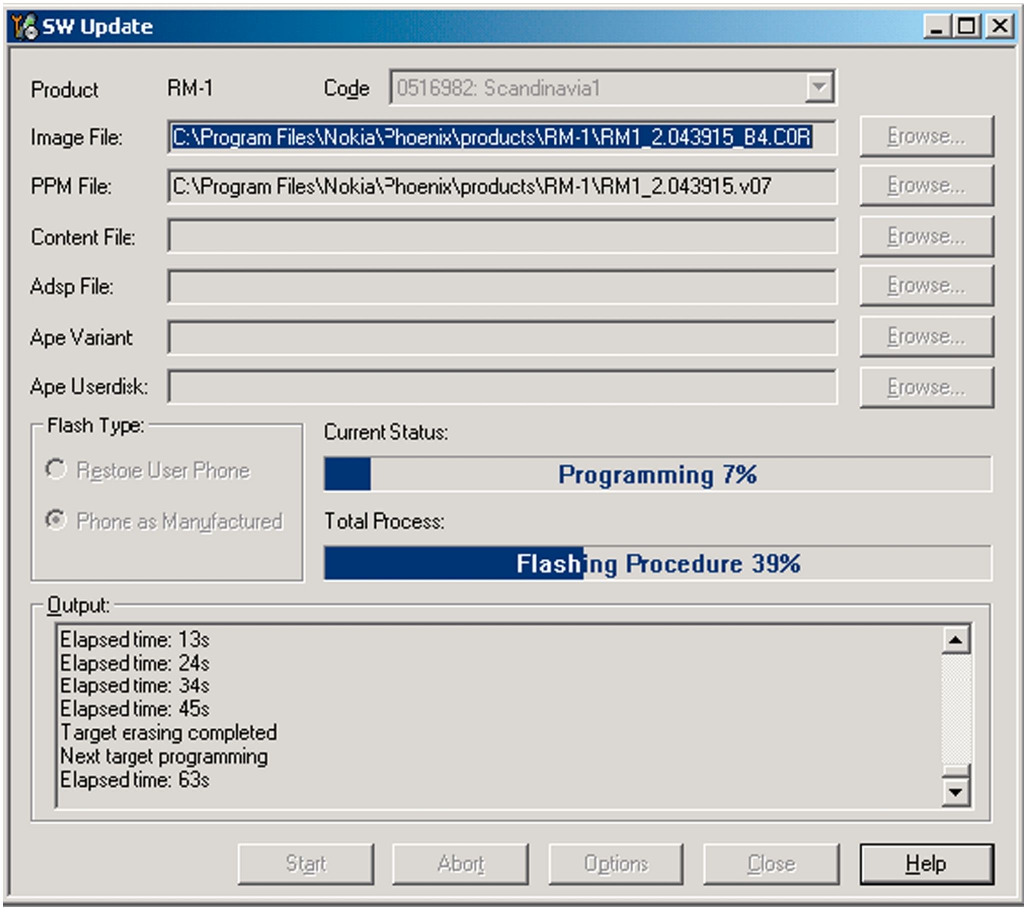
Flash Type:
○ Restore User Phone
● Phone as Manufactured

```
Reading phone information
No phone detected!
Reading flash settings from file(s)
Product string is empty.
Product code string is empty.
Production serial number is empty.
Procedure completed.
```

Product	is automatically set according to the phone support module which was opened manually, but the flash files cannot be found because the correct data cannot be read from the phone automatically.
Code	must be chosen manually, it determines the correct flash files to be used. Please choose the correct product code (can be seen in the phone type label) from the dropdown list.
Flash Type	must be set to **Phone as Manufactured**.

v To continue, click **Start**.

Progress bars and messages on the screen show actions during phone programming, please wait.


SW Update
Browse...
Browse...
Browse...
Browse...
Browse...
Browse...
Start
Abort
Options
Close
Help

Product RM-1
Code 0516982: Scandinavia1
Image File: C:\Program Files\Nokia\Phoenix\products\RM-1\RM1_2.043915_B4.C0R
PPM File: C:\Program Files\Nokia\Phoenix\products\RM-1\RM1_2.043915.v07
Content File:
Adsp File:
Ape Variant
Ape Userdisk:
Flash Type:
○ Restore User Phone
● Phone as Manufactured
Current Status: Programming 7%
Total Process: Flashing Procedure 39%
Output:

```
Elapsed time: 13s
Elapsed time: 24s
Elapsed time: 34s
Elapsed time: 45s
Target erasing completed
Next target programming
Elapsed time: 63s
```

Programming is completed when *Flashing Completed* message is displayed.

The product type designator and MCU SW version are displayed in the status bar.

vi Close the *SW Update* window and then choose **File→Close Product** .

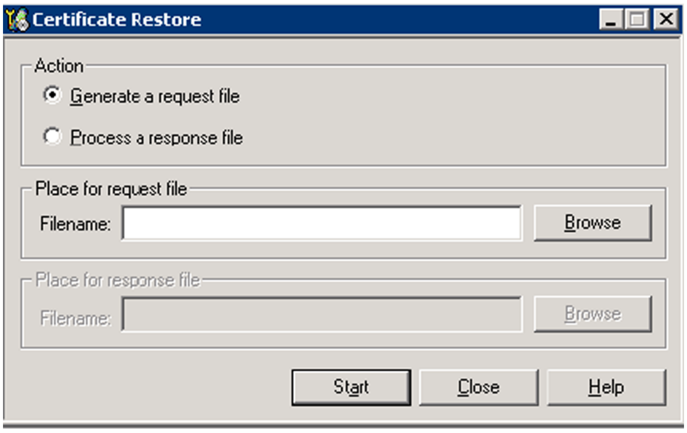
2. Create a *Request* file.

For this procedure, you must supply +12 V to CU-4 from an external power supply.

i To connect the phone with *Phoenix*, choose **File→Scan Product** .

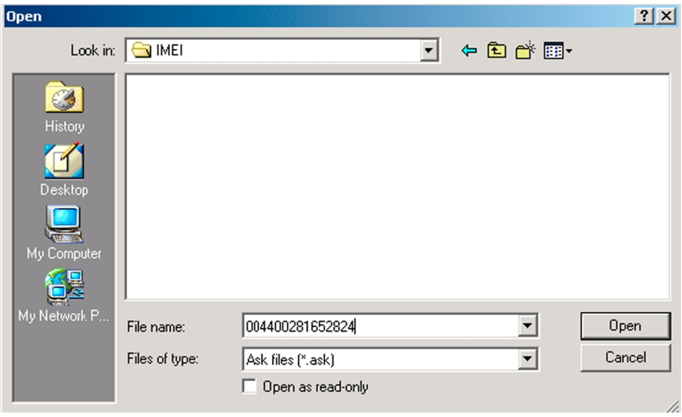
ii Choose **Tools→Certificate Restore** .

iii To choose a location for the request file, click **Browse**.


Certificate Restore
Browse
Browse
Start
Close
Help

Action
● Generate a request file
○ Process a response file
Place for request file
Filename:
Place for response file
Filename:

iv Name the file so that you can easily identify it, and click **Open**.

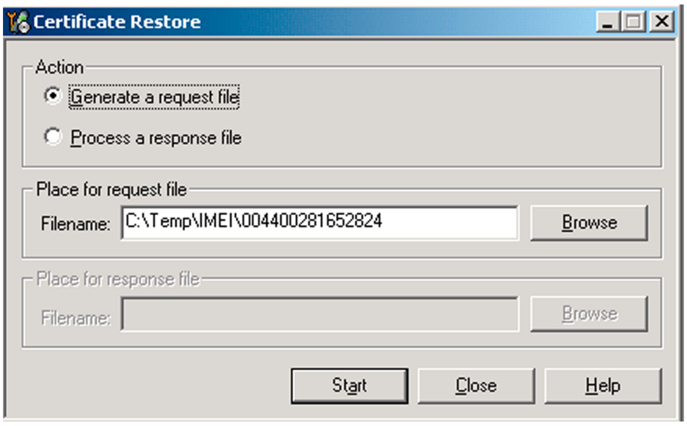

Open
Look in:
History
Desktop
My Computer
My Network P...
Open
Cancel
Open as read-only

Look in: IMEI

File name: 004400281652824

Files of type: Ask files (*.ask)

The name of the file and its location are shown.


Certificate Restore
Action
Process a response file
Place for request file
Browse
Place for response file
Filename:
Browse
Start
Close
Help

● Generate a request file

Filename: C:\Temp\IMEI\004400281652824

v To create the *Request* file, click **Start**.

vi When the file for certificate restore has been created, send it to Nokia as an e-mail attachment.

3. Restore certificate.

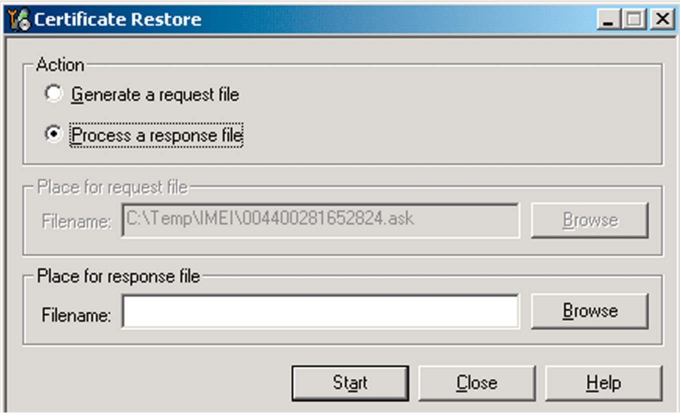
For this procedure, you must supply +12 V to CU-4 from an external power supply.

i Save the reply file sent by Nokia to your computer.

ii Start *Phoenix* service software.

iii Choose **File→Scan Product** .

iv From the **Tools** menu, choose **Certificate Restore** and select **Process a response file** in the *Action* pane.


Certificate Restore
Browse
Browse
Start
Close
Help

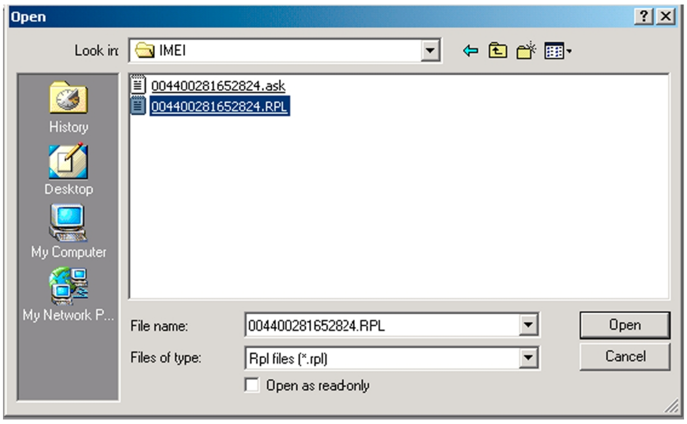
Action
○ Generate a request file
● Process a response file

Place for request file
Filename: C:\Temp\IMEI\004400281652824.ask

Place for response file
Filename:

v To choose the location where response file is saved, click **Browse**.

vi Click **Open**.


Open
History
Desktop
My Computer
My Network P...
Open
Cancel

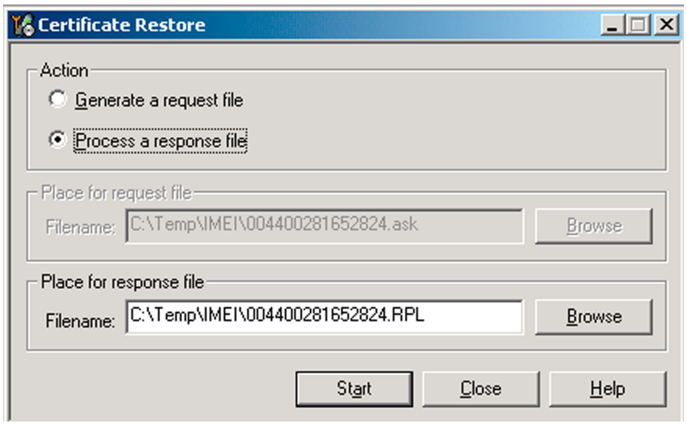
Look in: IMEI

004400281652824.ask
004400281652824.RPL

File name: 004400281652824.RPL
Files of type: Rpl files (*.rpl)
☐ Open as read-only

The name of the file and the path where it is located are shown.

vii To write the file to phone, click **Start**.


Certificate Restore
Browse
Browse
Start
Close
Help

Action
○ Generate a request file
● Process a response file

Place for request file
Filename: C:\Temp\IMEI\004400281652824.ask

Place for response file
Filename: C:\Temp\IMEI\004400281652824.RPL

Next actions

After a successful rewrite, you must retune the phone completely by using *Phoenix* tuning functions.

Important: Perform all tunings: RF, BB, and UI.

Display module troubleshooting

General instructions for display troubleshooting

The first step is to verify with a working display that the fault is not on the display module itself. The display module cannot be repaired.

The second step is to check that the cellular engine is working normally. This can be done by connecting the phone to a docking station and starting Phoenix service software. With the help of Phoenix read the phone information to check that also application engine is functioning normally (you should be able to read the APE ID).

After these checks proceed to the display troubleshooting flowcharts. Use the Display Test tool in Phoenix to find the detailed fault mode.

Operating modes of the display

Display is in a normal mode when the phone is in active use.

Display is in a partial idle mode when the phone is in the screen saver mode.

Display is in OFF mode when the phone is in the full idle mode (idle LED is flashing).

The operating modes of the display can be controlled with the help of Phoenix.

Table 10 Display module troubleshooting cases

Display blank	There is no image on the display and Idle LED does not flash. Display looks the same when the phone is on as it does when the phone is off. The backlight can be on in some cases.
Image on the display not correct	Image on the display can be corrupted or part of the image can be missing. If part of image is missing change the display module. If the image is otherwise corrupted, follow the appropriate troubleshooting diagram.
Backlight dim or not working at all	Backlight LED components are inside the display module. Backlight failure can also be in the connector or in the backlight power source in the main engine of the phone. Backlight is also controlled automatically by the ambient light sensor. This means that in case the display is working (image OK) but the backlight is not, follow the Display and keyboard backlight troubleshooting..
Visual defects (pixel)	Pixel defects can be checked by controlling the display with Phoenix. Use both colours, black and white, on a full screen. The display may have some random pixel defects that are acceptable for this type of display. The criteria when pixel defects are regarded as a display failure, resulting in a replacement of the display, are presented the table below.

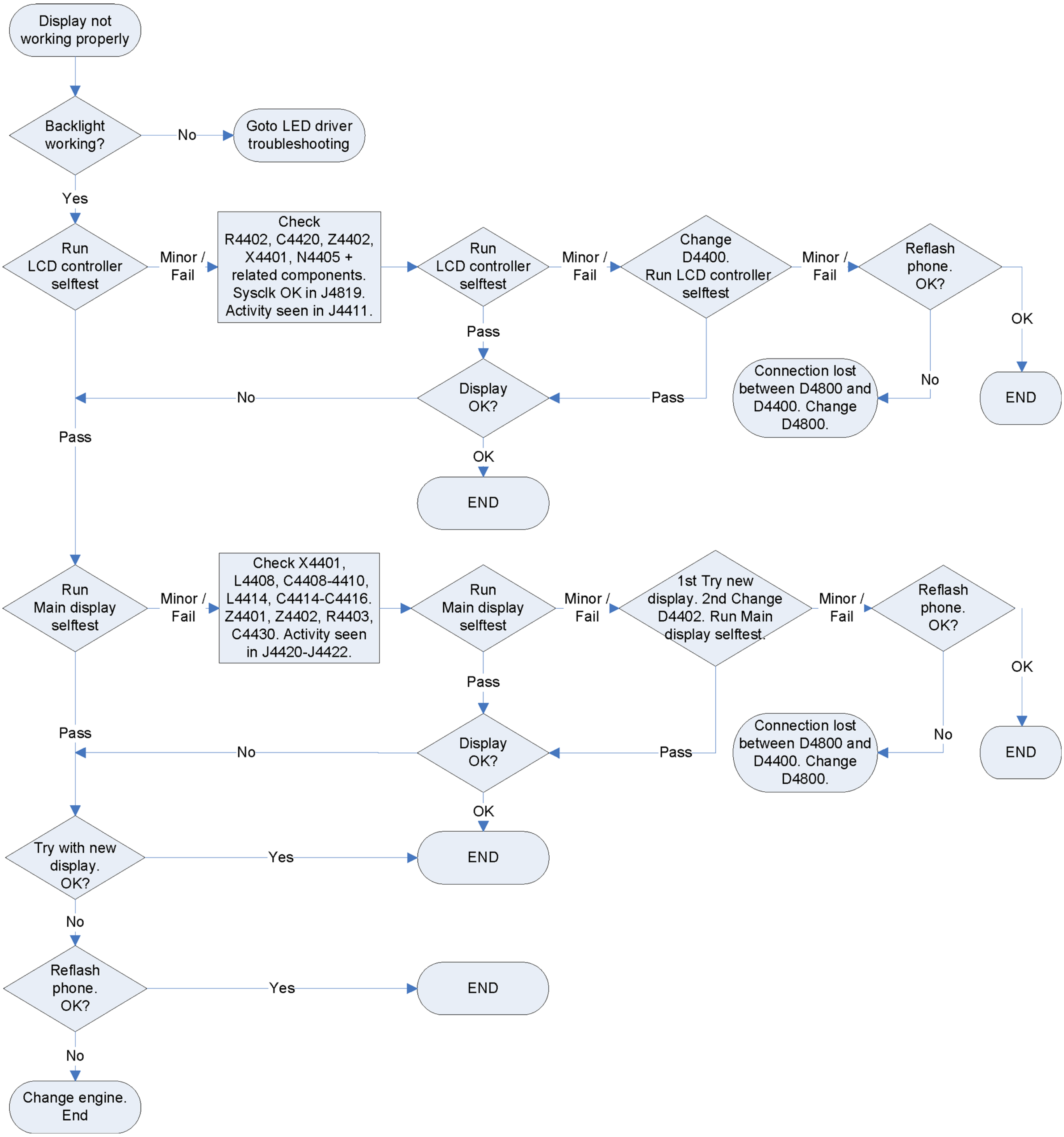
Table 11 Pixel defects

Item		White dot defect				Black dot defect	Total
1	Defect counts	R	G	B	White Dot Total	1	1
		1	1	1	1		
2	Combined defect counts	Not allowed. Two single dot defects that are within 5 mm of each other should be interpreted as combined dot defect.					

Note: Blinking pixels are not allowed in normal operating temperatures and light conditions.

Display fault troubleshooting

Troubleshooting flow


Display not working properly
Backlight working?
No
Goto LED driver troubleshooting
Yes
Run LCD controller selftest
Minor / Fail
Check R4402, C4420, Z4402, X4401, N4405 + related components. Sysclk OK in J4819. Activity seen in J4411.
Run LCD controller selftest
Minor / Fail
Change D4400. Run LCD controller selftest
Minor / Fail
Reflash phone. OK?
OK
END
No
Connection lost between D4800 and D4400. Change D4800.
Pass
Pass
Display OK?
No
OK
END
Pass
Run Main display selftest
Minor / Fail
Check X4401, L4408, C4408-4410, L4414, C4414-C4416. Z4401, Z4402, R4403, C4430. Activity seen in J4420-J4422.
Run Main display selftest
Minor / Fail
1st Try new display. 2nd Change D4402. Run Main display selftest.
Minor / Fail
Reflash phone. OK?
OK
END
No
Connection lost between D4800 and D4400. Change D4800.
Pass
Pass
Display OK?
No
Pass
OK
END
Try with new display. OK?
Yes
END
No
Reflash phone. OK?
Yes
END
No
Change engine. End

Display and keyboard backlight troubleshooting

Context

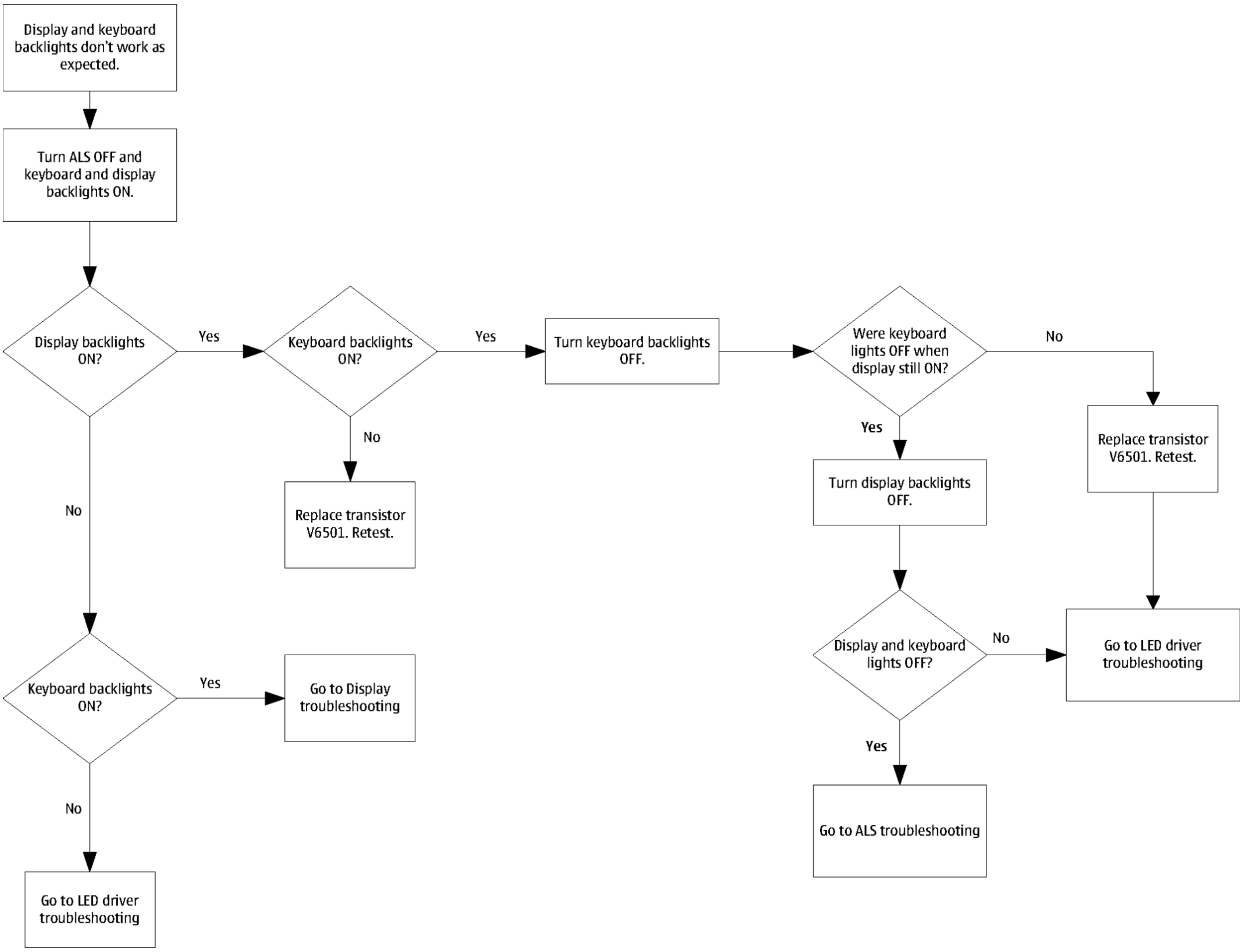
The device has one LED driver that provides current for both display and keyboard backlights.

Keyboard backlights are turned ON only in dark conditions. This is controlled by the Ambient Light Sensor (ALS). Also the brightness of the display is adjusted by the ambient light sensor.

You can enable/disable ALS with the help of Phoenix service software.

Display brightness can be adjusted manually, if ALS is disabled. If the ambient light sensor is enabled, it adjusts the display brightness automatically.

Troubleshooting flow

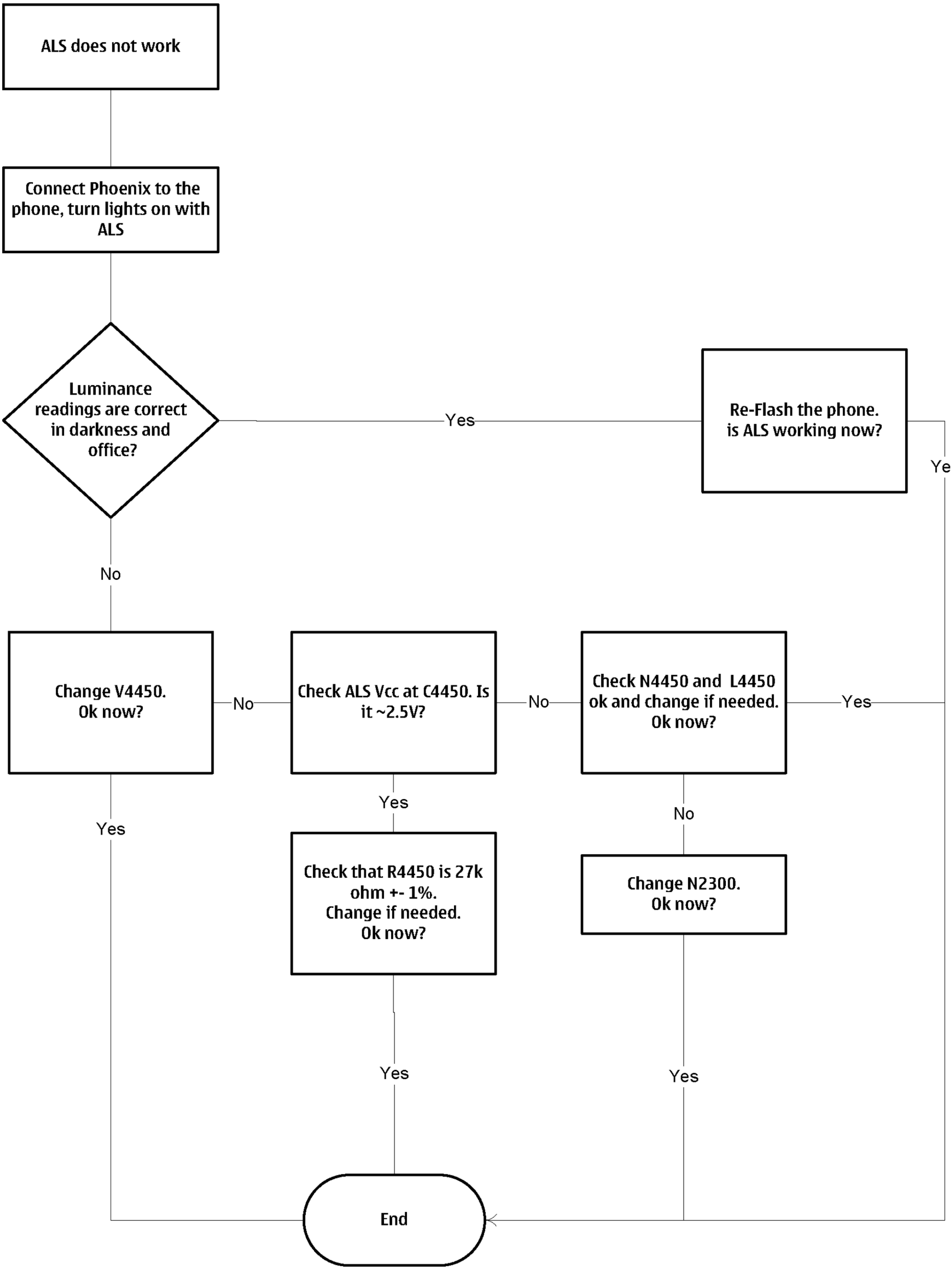

Display and keyboard backlights don't work as expected.
Turn ALS OFF and keyboard and display backlights ON.
Display backlights ON?
Yes
Keyboard backlights ON?
Yes
Turn keyboard backlights OFF.
Were keyboard lights OFF when display still ON?
No
Replace transistor V6501. Retest.
Yes
Turn display backlights OFF.
No
Replace transistor V6501. Retest.
No
Display and keyboard lights OFF?
No
Go to LED driver troubleshooting
Yes
Go to ALS troubleshooting
Keyboard backlights ON?
Yes
Go to Display troubleshooting
No
Go to LED driver troubleshooting

ALS troubleshooting

Context

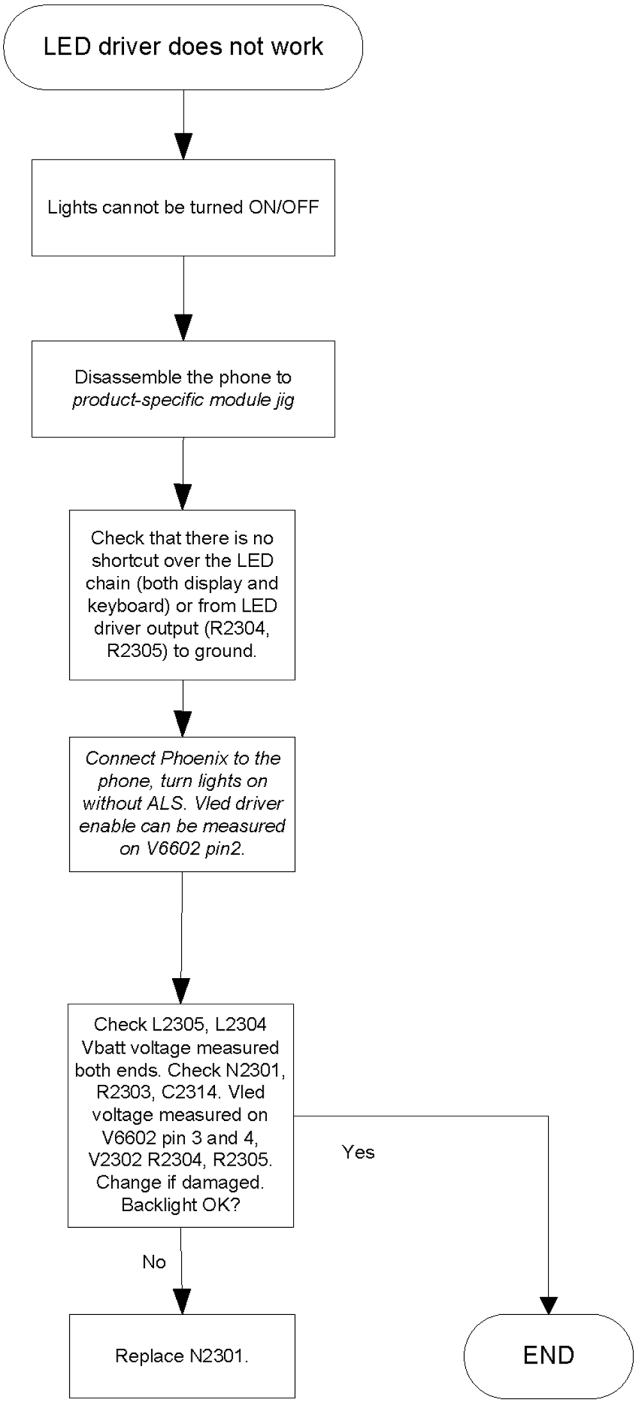
- If a phototransistor is broken, replace it with a typical phototransistor.
- If the phototransistor is changed, the calibration value in the phone memory has to be changed to the default value ‘1’.

Troubleshooting flow


ALS does not work
Connect Phoenix to the phone, turn lights on with ALS
Luminance readings are correct in darkness and office?
Yes
Re-Flash the phone. is ALS working now?
Yes
No
Change V4450. Ok now?
No
Check ALS Vcc at C4450. Is it ~2.5V?
No
Check N4450 and L4450 ok and change if needed. Ok now?
Yes
Yes
Yes
No
Check that R4450 is 27k ohm +- 1%. Change if needed. Ok now?
Change N2300. Ok now?
Yes
Yes
End

LED driver troubleshooting

Troubleshooting flow


LED driver does not work
Lights cannot be turned ON/OFF
Disassemble the phone to *product-specific module jig*
Check that there is no shortcut over the LED chain (both display and keyboard) or from LED driver output (R2304, R2305) to ground.
Connect Phoenix to the phone, turn lights on without ALS. Vled driver enable can be measured on V6602 pin2.
Check L2305, L2304 Vbatt voltage measured both ends. Check N2301, R2303, C2314. Vled voltage measured on V6602 pin 3 and 4, V2302 R2304, R2305. Change if damaged. Backlight OK?
Yes
No
Replace N2301.
END

Bluetooth troubleshooting

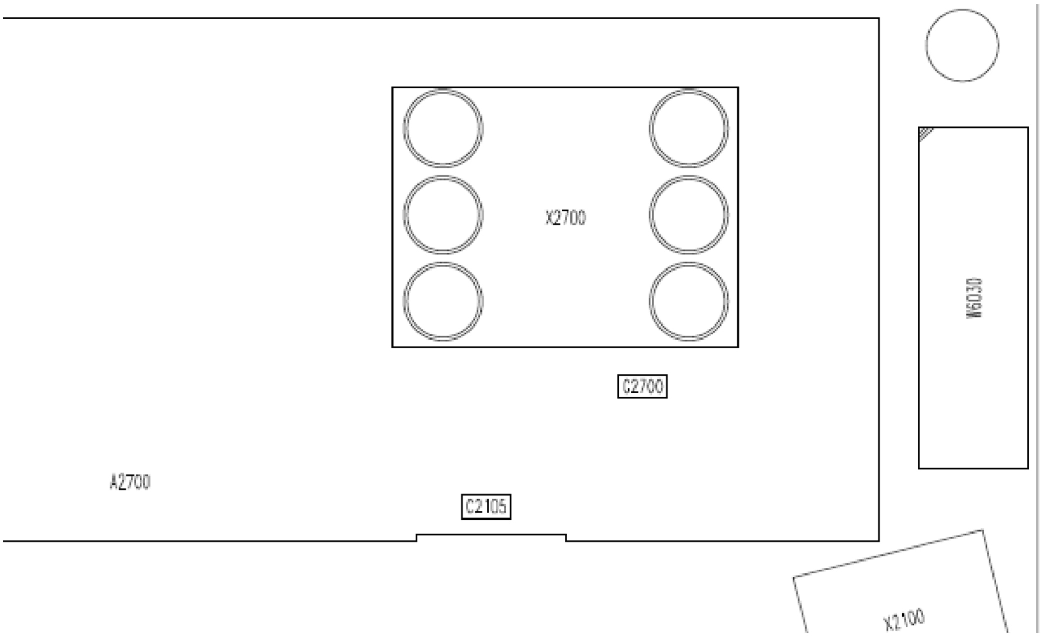
Introduction to Bluetooth troubleshooting

There are two main Bluetooth problems that can occur:

Problem	Description
Detachment of the BT antenna.	This would most likely happen if the device has been dropped repeatedly to the ground. It could cause the BT antenna to become loose or partially detached from the PWB. (see next page for details about BT antenna HW and Mechanics)
A malfunction in the BT ASIC, BB ASICs or Phone's BT SMD components.	This is unpredictable and could have many causes i.e. SW or HW related.

The main issue is to find out if the problem is related to the BT antenna or related to the BT system or the phone's BB and then replace/fix the faulty component.

Location of the BT antenna



Bluetooth settings for Phoenix

Steps

1. Start *Phoenix* service software.
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing→Bluetooth LOCALS** .
5. Locate JBT-9's serial number (12 digits) found in the type label on the back of JBT-9.

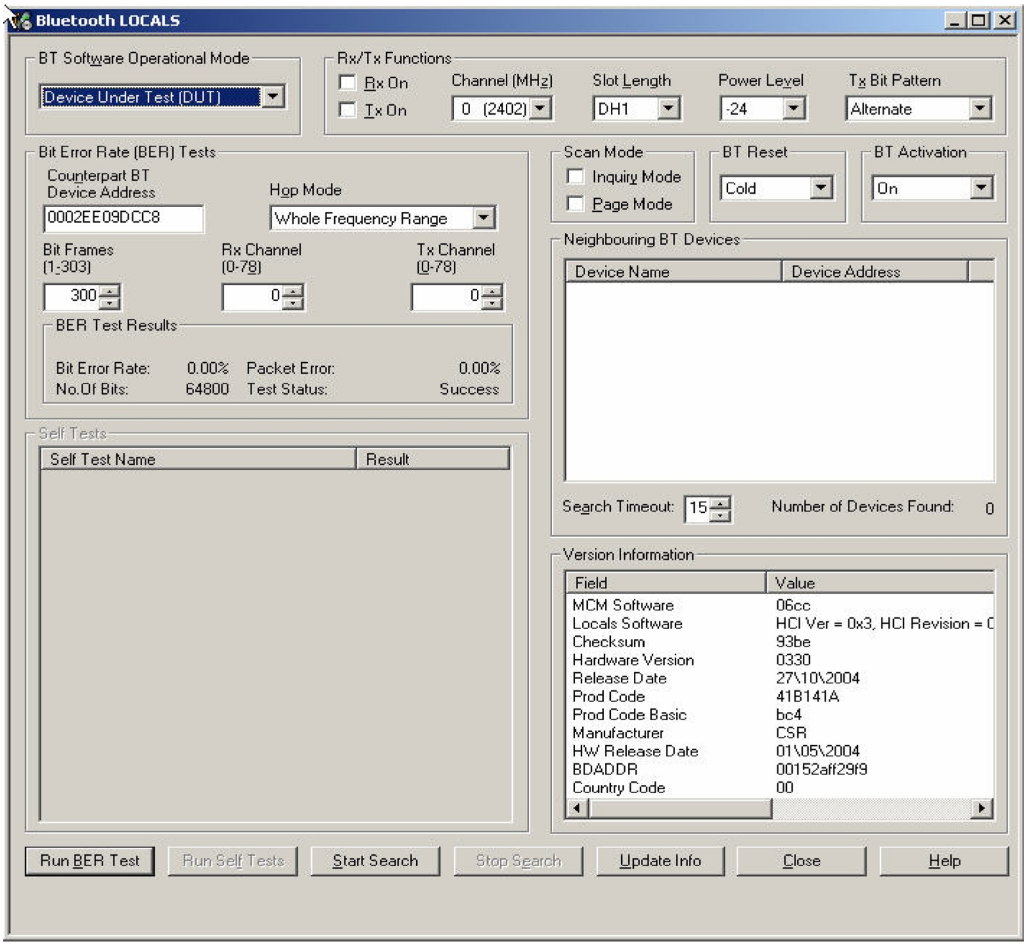
   In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.

6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.

   This needs to be done only once provided that JBT-9 is not changed.
7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

Results

Bit Error Rate test result is displayed in the *Bit Error Rate (BER) Tests* pane in the *Bluetooth LOCALS* window.



BT Software Operational Mode: Device Under Test (DUT)

Rx/Tx Functions: ☐ Rx On ☐ Tx On; Channel (MHz): 0 (2402); Slot Length: DH1; Power Level: -24; Tx Bit Pattern: Alternate

Bit Error Rate (BER) Tests

Counterpart BT Device Address: 0002EE09DCC8
Hop Mode: Whole Frequency Range
Bit Frames (1-303): 300
Rx Channel (0-78): 0
Tx Channel (0-78): 0

BER Test Results

Bit Error Rate: 0.00%
Packet Error: 0.00%
No.Of Bits: 64800
Test Status: Success

Self Tests

Self Test Name	Result

Scan Mode: ☐ Inquiry Mode ☐ Page Mode
BT Reset: Cold
BT Activation: On

Neighbouring BT Devices

Device Name	Device Address

Search Timeout: 15
Number of Devices Found: 0

Version Information

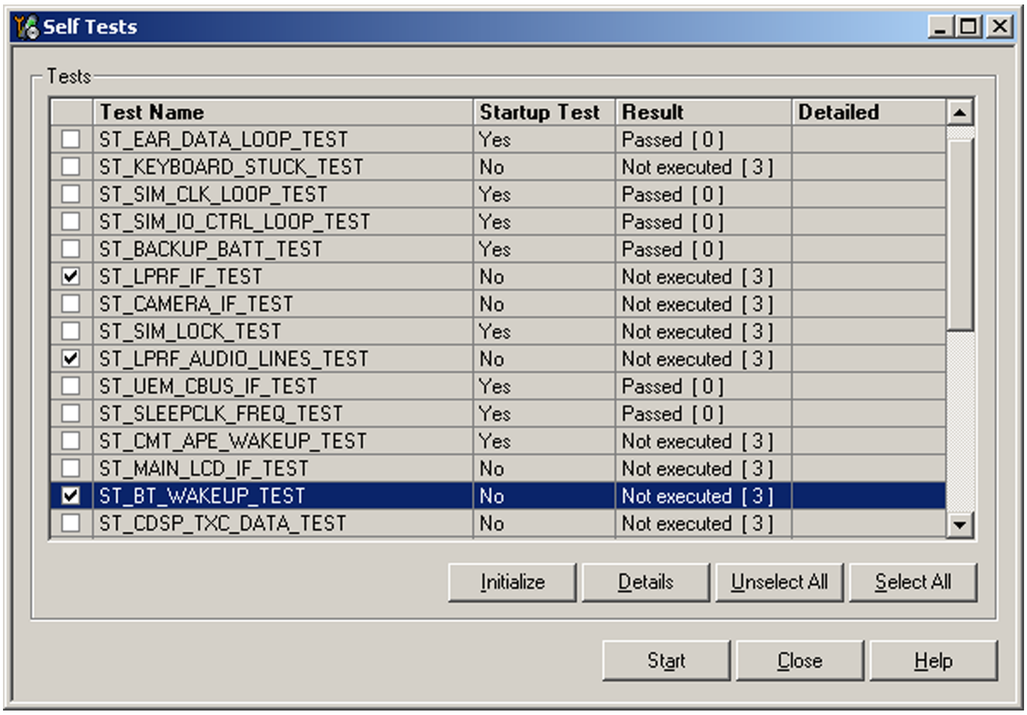
Field	Value
MCM Software	06cc
Locals Software	HCI Ver = 0x3, HCI Revision =
Checksum	93be
Hardware Version	0330
Release Date	27\10\2004
Prod Code	41B141A
Prod Code Basic	bc4
Manufacturer	CSR
HW Release Date	01\05\2004
BDADDR	00152aff29f9
Country Code	00

Bluetooth self tests in Phoenix

Steps

1. Start *Phoenix* service software.
2. Choose**File→Scan Product.**
3. Place the phone to a flash adapter.
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**

7. To run the tests, click **Start**.

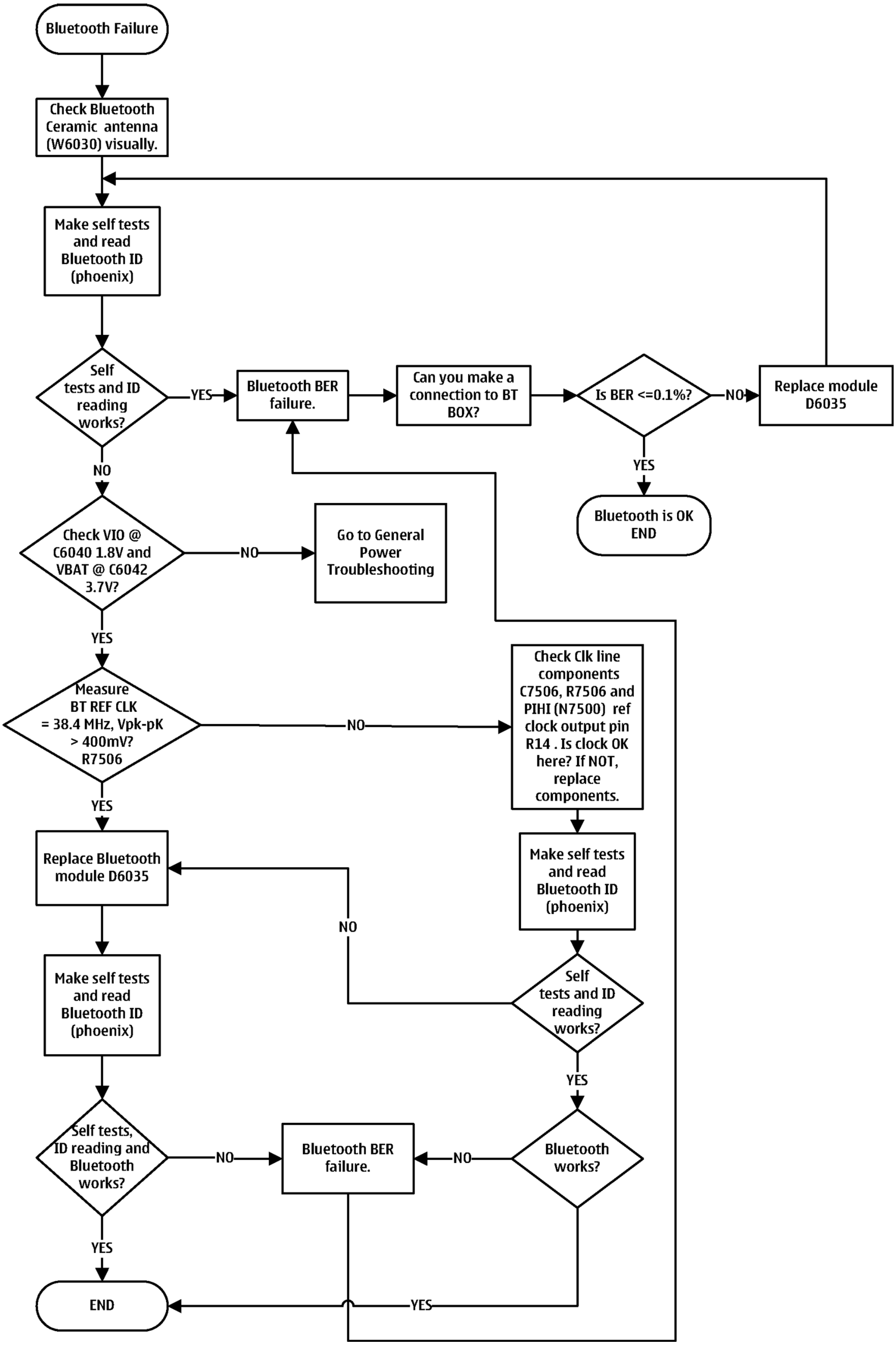


	Test Name	Startup Test	Result	Detailed
☐	ST_EAR_DATA_LOOP_TEST	Yes	Passed [0]	
☐	ST_KEYBOARD_STUCK_TEST	No	Not executed [3]	
☐	ST_SIM_CLK_LOOP_TEST	Yes	Passed [0]	
☐	ST_SIM_IO_CTRL_LOOP_TEST	Yes	Passed [0]	
☐	ST_BACKUP_BATT_TEST	Yes	Passed [0]	
☑	ST_LPRF_IF_TEST	No	Not executed [3]	
☐	ST_CAMERA_IF_TEST	No	Not executed [3]	
☐	ST_SIM_LOCK_TEST	Yes	Not executed [3]	
☑	ST_LPRF_AUDIO_LINES_TEST	No	Not executed [3]	
☐	ST_UEM_CBUS_IF_TEST	Yes	Passed [0]	
☐	ST_SLEEPCLK_FREQ_TEST	Yes	Passed [0]	
☐	ST_CMT_APE_WAKEUP_TEST	Yes	Not executed [3]	
☐	ST_MAIN_LCD_IF_TEST	No	Not executed [3]	
☑	ST_BT_WAKEUP_TEST	No	Not executed [3]	
☐	ST_CDSP_TXC_DATA_TEST	No	Not executed [3]	

Figure 8 Bluetooth self tests in *Phoenix*

Bluetooth failure troubleshooting

Troubleshooting flow


Bluetooth Failure
Check Bluetooth Ceramic antenna (W6030) visually.
Make self tests and read Bluetooth ID (phoenix)
Self tests and ID reading works?
YES
Bluetooth BER failure.
Can you make a connection to BT BOX?
Is BER <=0.1%?
NO
Replace module D6035
YES
Bluetooth is OK END
NO
Check VIO @ C6040 1.8V and VBAT @ C6042 3.7V?
NO
Go to General Power Troubleshooting
YES
Measure BT REF CLK = 38.4 MHz, Vpk-pK > 400mV? R7506
NO
Check Clk line components C7506, R7506 and PIHI (N7500) ref clock output pin R14 . Is clock OK here? If NOT, replace components.
YES
Replace Bluetooth module D6035
Make self tests and read Bluetooth ID (phoenix)
NO
Make self tests and read Bluetooth ID (phoenix)
Self tests and ID reading works?
YES
Self tests, ID reading and Bluetooth works?
NO
Bluetooth BER failure.
NO
Bluetooth works?
YES
END
YES

Audio troubleshooting

Audio troubleshooting test instructions

Differential external earpiece and internal earpiece outputs can be measured either with a single-ended or a differential probe.

When measuring with a single-ended probe each output is measured against the ground.

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 2kHz.

The input signal for each loop test can be either single-ended or differential.

Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- Current probe (Internal handsfree DPMA output measurement)
- Phoenix service software
- Battery voltage 3.7V

Test procedure

Audio can be tested using the Phoenix audio routings option. Three different audio loop paths can be activated:

- External microphone to Internal earpiece
- External microphone to Internal handsfree speaker
- Internal microphone to External earpiece

Each audio loop sets routing from the specified input to the specified output enabling a quick in-out test. Loop path gains are fixed and they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

Phoenix audio loop tests and test results

The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7V.

Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

The gain values presented in the table apply for a differential output vs. single-ended/differential input.

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Differential output voltage [mVp-p]	Output DC level [V]	Output current [mA]
External Mic to External Earpiece	XMICP and GND	HSEAR R P, HSEAR R N and GND	-2.9	1000	720	1.2	NA
		HSEAR P, HSEAR N and GND					
	XMICN and GND	HSEAR R P, HSEAR R N and GND					
		HSEAR P, HSEAR N and GND					
External Mic to Internal Earpiece	XMICP and GND	EarP and GND	-4.5	1000	600	1.2	NA
		EarN and GND					
	XMICN and GND	EarP and GND					
		EarN and GND					
External Mic to Internal handsfree	XMICP and GND	X2102 pads B2103 pads	-5	1000	560	0	25mA (calc.)
	XMICN and GND	X2001 pads B2103 pads					
Internal Mic to External Earpiece	B2202 (OUT/ GND)	HSEAR R P, HSEAR R N and GND	22.7	100	1360	1.2	NA
		HSEAR P, HSEAR N and GND					
		HSEAR R P, HSEAR R N and GND					
		HSEAR P, HSEAR N and GND					

Measurement data

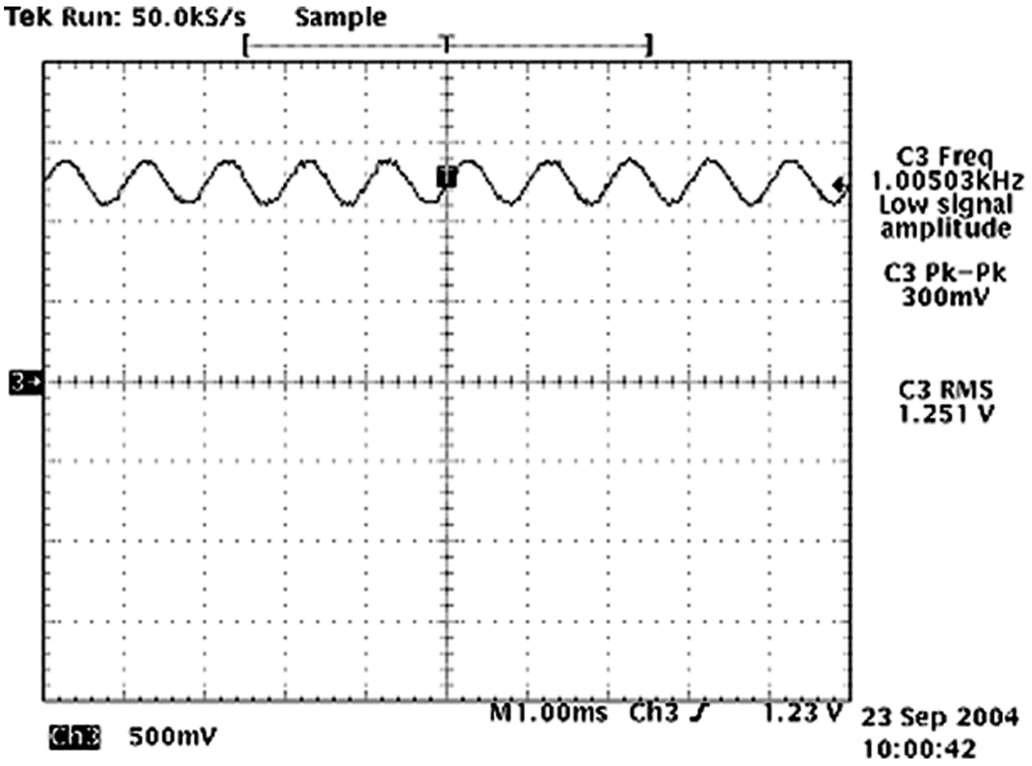
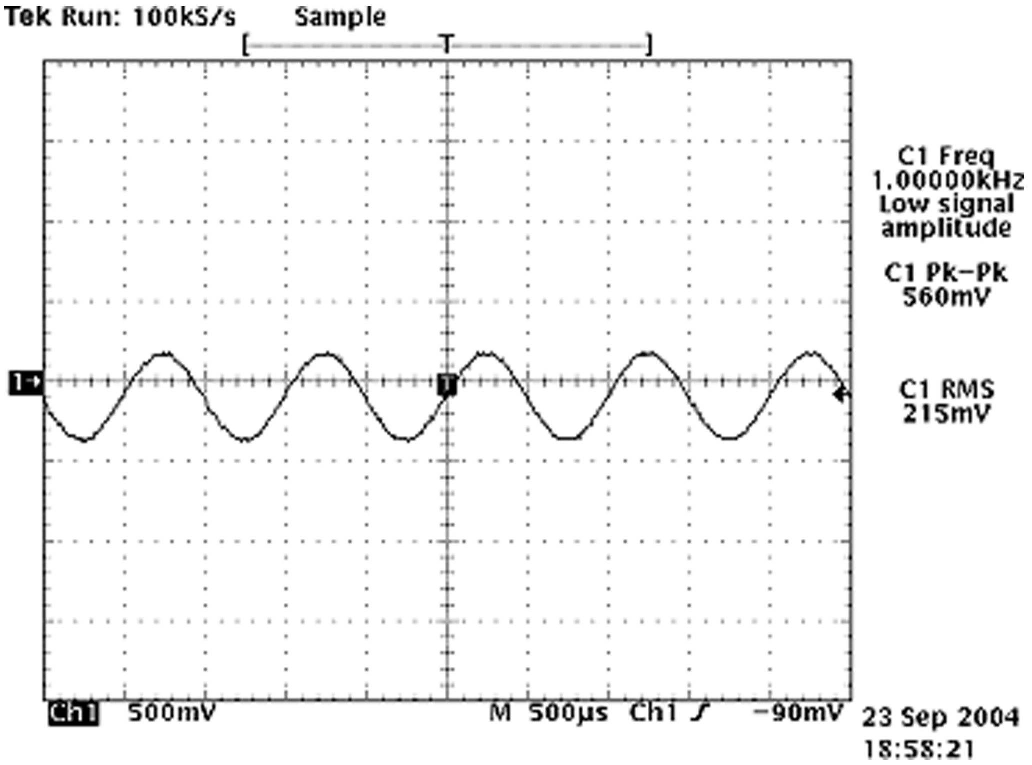


Figure 9 Single-ended output waveform of the Ext_in_HP_out measurement when earpiece is connected.



If a special low-pass filter designed for measuring digital amplifiers is unavailable, the measurement must be performed with a current probe and the input signal frequency must be 2kHz.

Figure 10 Differential output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected.

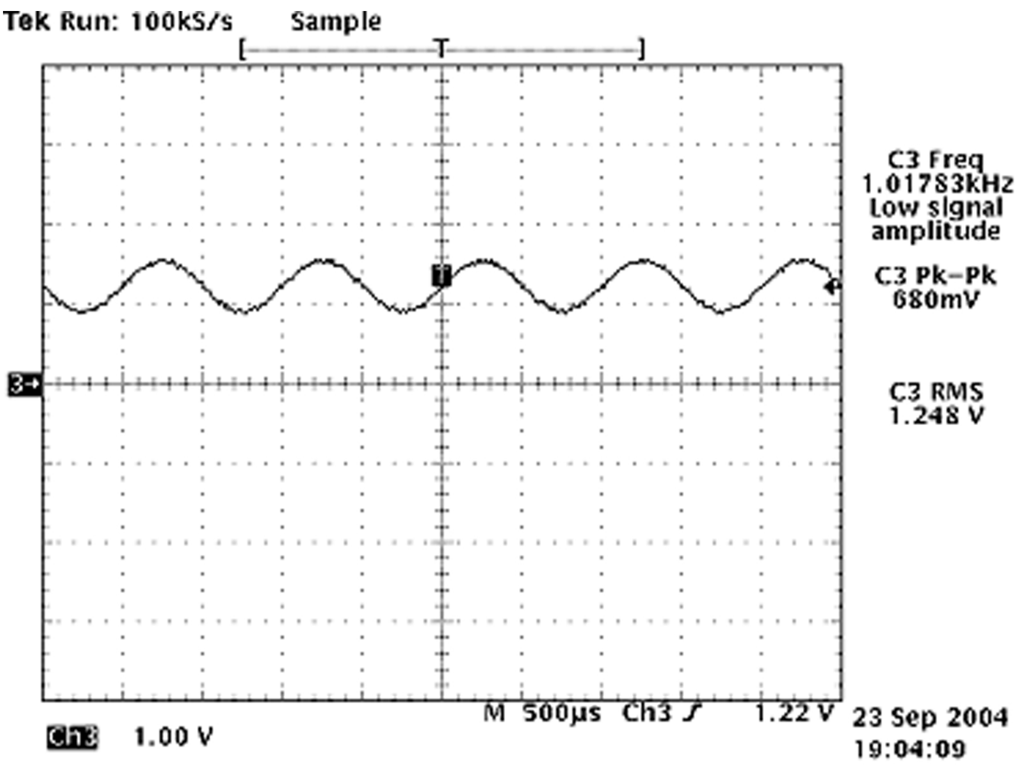
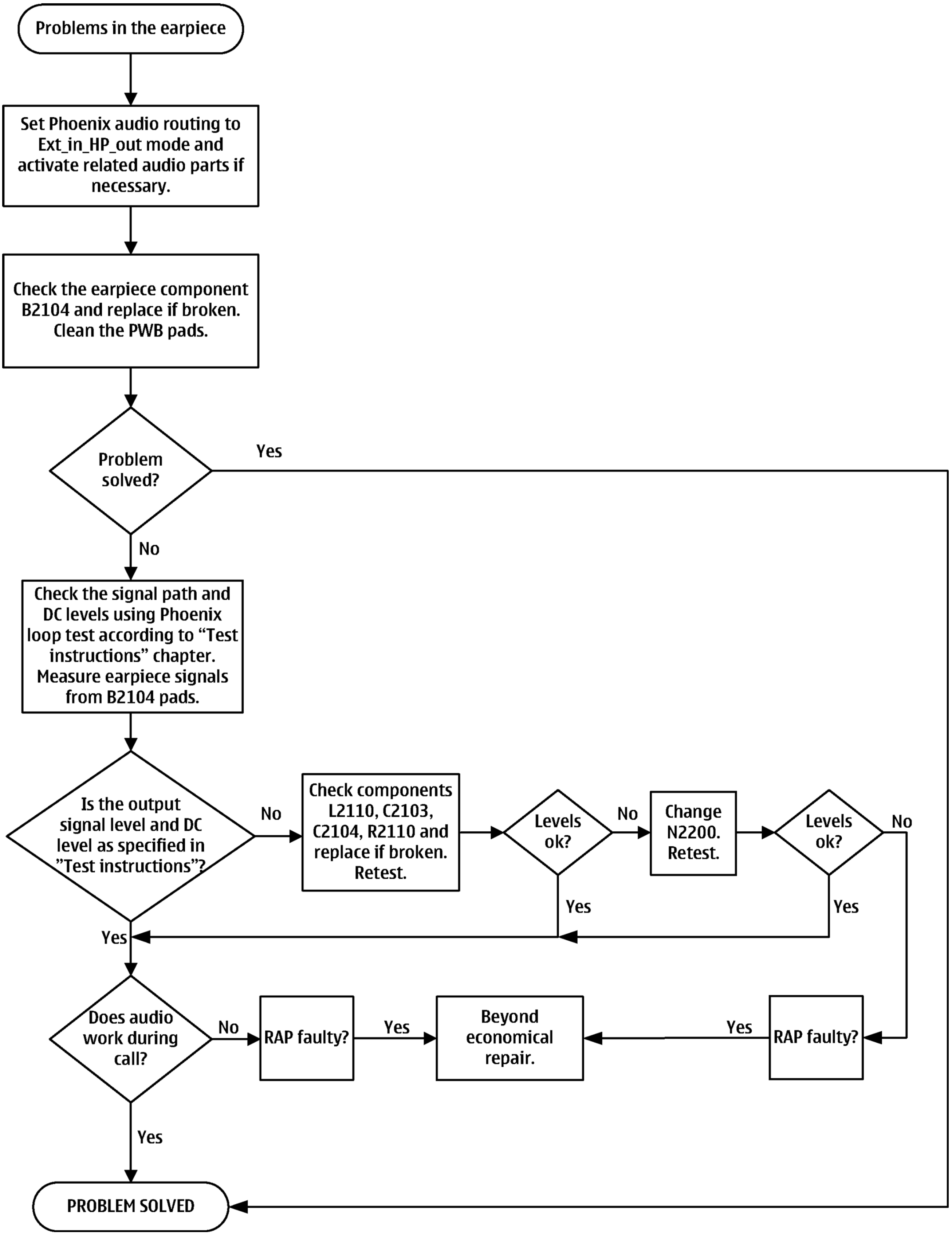


Figure 11 Single-ended output waveform of the HP_in_Ext_out loop when microphone is connected.

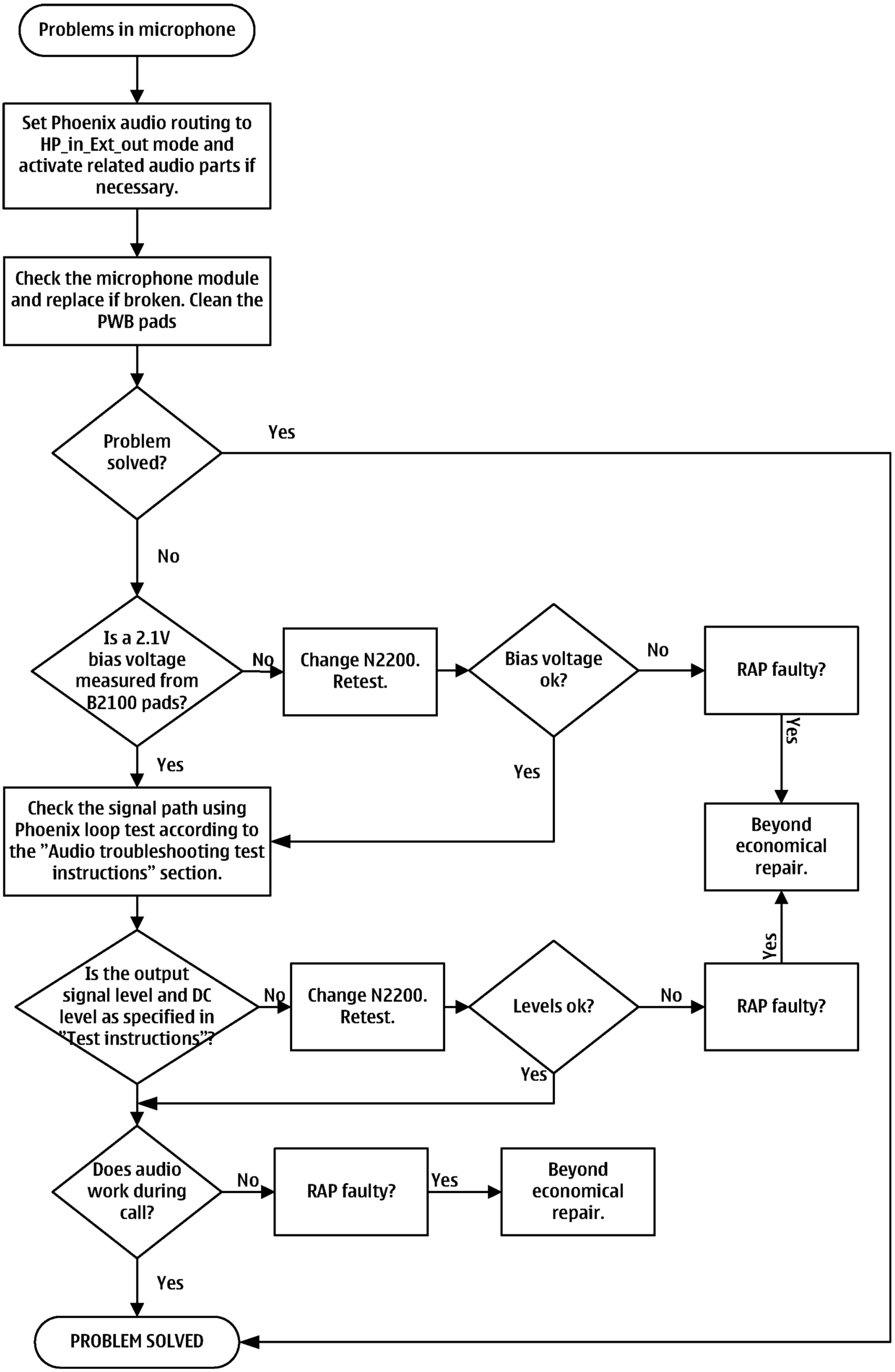
Internal earpiece troubleshooting

Troubleshooting flow


Problems in the earpiece
Set Phoenix audio routing to Ext_in_HP_out mode and activate related audio parts if necessary.
Check the earpiece component B2104 and replace if broken. Clean the PWB pads.
Problem solved?
Yes
No
Check the signal path and DC levels using Phoenix loop test according to “Test instructions” chapter. Measure earpiece signals from B2104 pads.
Is the output signal level and DC level as specified in ”Test instructions”?
No
Check components L2110, C2103, C2104, R2110 and replace if broken. Retest.
Levels ok?
No
Change N2200. Retest.
Levels ok?
No
Yes
Yes
Yes
Does audio work during call?
No
RAP faulty?
Yes
Beyond economical repair.
Yes
RAP faulty?
Yes
PROBLEM SOLVED

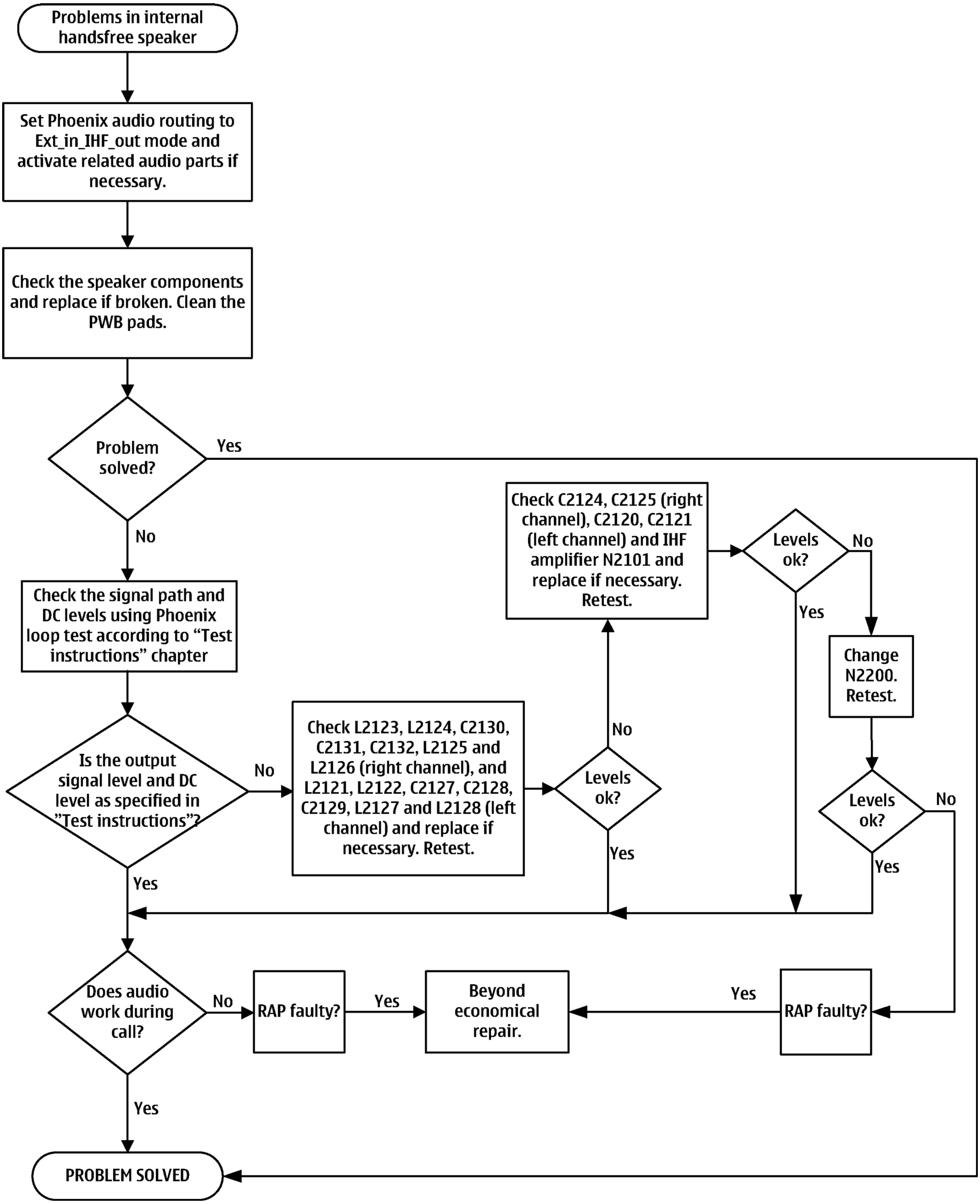
Internal microphone troubleshooting

Troubleshooting flow


Problems in microphone
Set Phoenix audio routing to HP_in_Ext_out mode and activate related audio parts if necessary.
Check the microphone module and replace if broken. Clean the PWB pads
Problem solved?
Yes
No
Is a 2.1V bias voltage measured from B2100 pads?
No
Change N2200. Retest.
Bias voltage ok?
No
RAP faulty?
Yes
Beyond economical repair.
Yes
Yes
Check the signal path using Phoenix loop test according to the "Audio troubleshooting test instructions" section.
Is the output signal level and DC level as specified in "Test instructions"?
No
Change N2200. Retest.
Levels ok?
No
RAP faulty?
Yes
Yes
Does audio work during call?
No
RAP faulty?
Yes
Beyond economical repair.
Yes
PROBLEM SOLVED

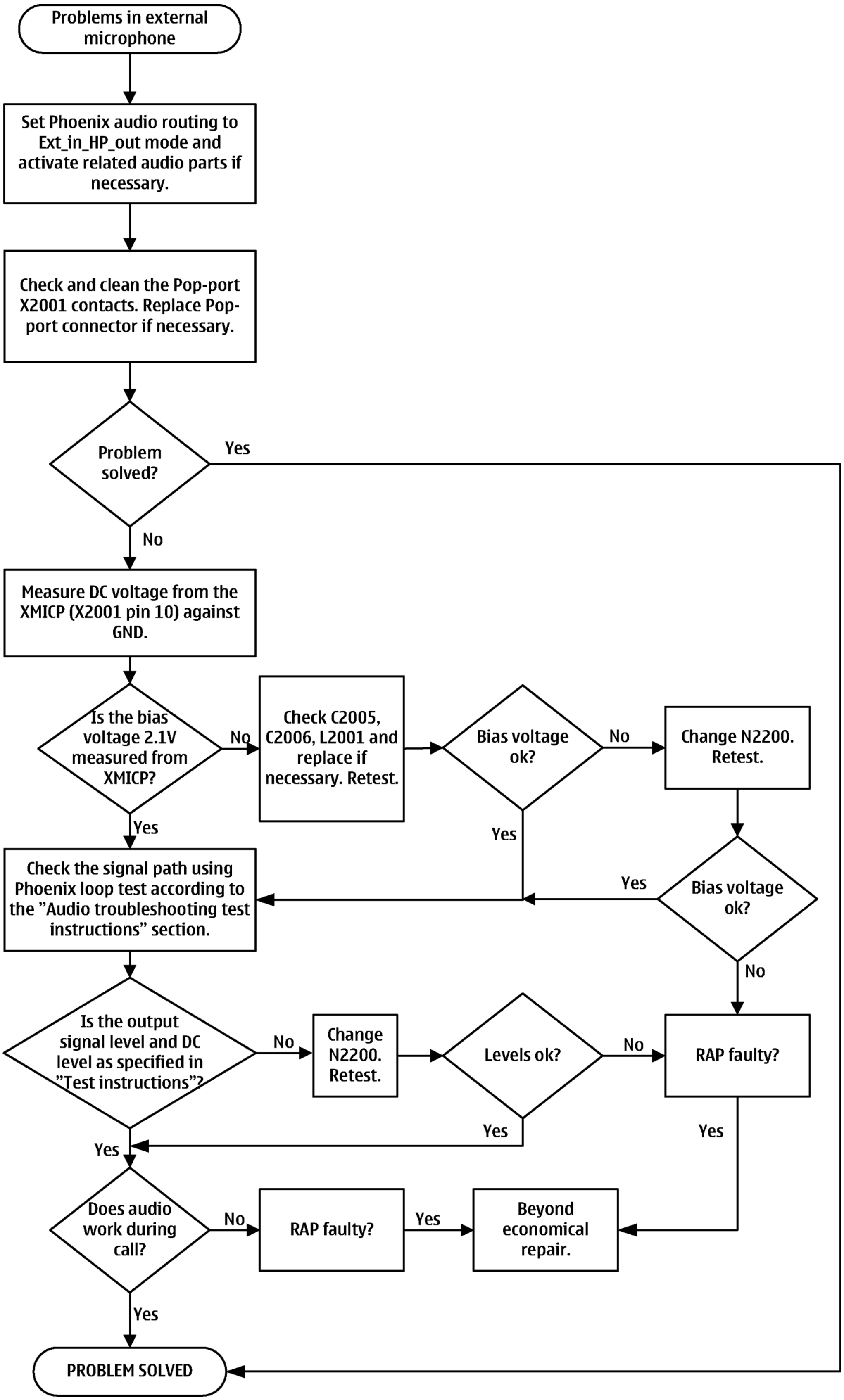
IHF troubleshooting

Troubleshooting flow


Problems in internal handsfree speaker
Set Phoenix audio routing to Ext_in_IHF_out mode and activate related audio parts if necessary.
Check the speaker components and replace if broken. Clean the PWB pads.
Problem solved?
Yes
No
Check the signal path and DC levels using Phoenix loop test according to “Test instructions” chapter
Is the output signal level and DC level as specified in ”Test instructions”?
No
Yes
Check L2123, L2124, C2130, C2131, C2132, L2125 and L2126 (right channel), and L2121, L2122, C2127, C2128, C2129, L2127 and L2128 (left channel) and replace if necessary. Retest.
Levels ok?
No
Yes
Check C2124, C2125 (right channel), C2120, C2121 (left channel) and IHF amplifier N2101 and replace if necessary. Retest.
Levels ok?
No
Yes
Change N2200. Retest.
Levels ok?
No
Yes
Does audio work during call?
No
Yes
RAP faulty?
Yes
Beyond economical repair.
Yes
RAP faulty?
PROBLEM SOLVED

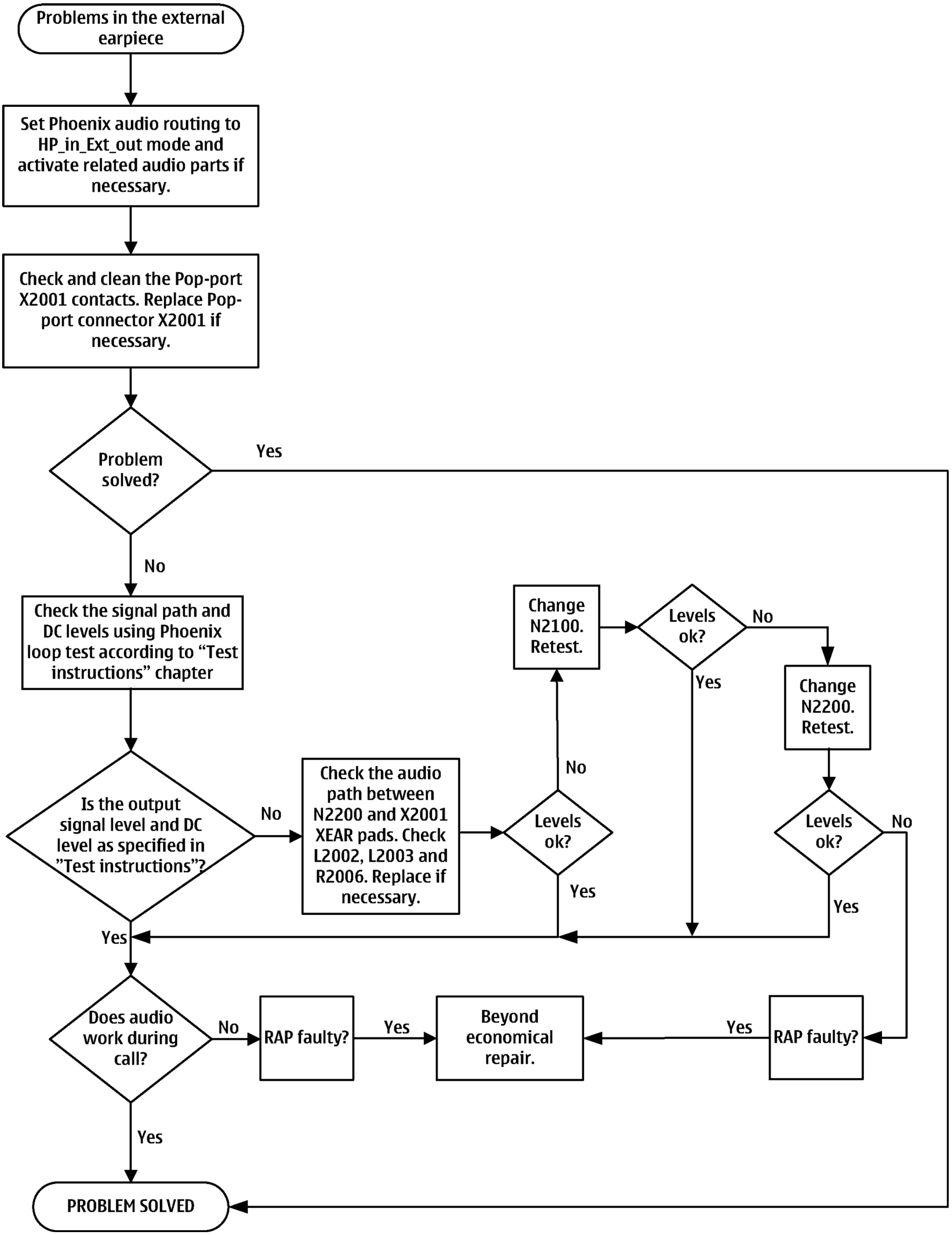
External microphone troubleshooting

Troubleshooting flow


Problems in external microphone
Set Phoenix audio routing to Ext_in_HP_out mode and activate related audio parts if necessary.
Check and clean the Pop-port X2001 contacts. Replace Pop-port connector if necessary.
Problem solved?
Yes
No
Measure DC voltage from the XMICP (X2001 pin 10) against GND.
Is the bias voltage 2.1V measured from XMICP?
No
Check C2005, C2006, L2001 and replace if necessary. Retest.
Bias voltage ok?
No
Change N2200. Retest.
Yes
Yes
Bias voltage ok?
No
Check the signal path using Phoenix loop test according to the "Audio troubleshooting test instructions" section.
Yes
Is the output signal level and DC level as specified in "Test instructions"?
No
Change N2200. Retest.
Levels ok?
No
RAP faulty?
Yes
Yes
Yes
Does audio work during call?
No
RAP faulty?
Yes
Beyond economical repair.
Yes
PROBLEM SOLVED

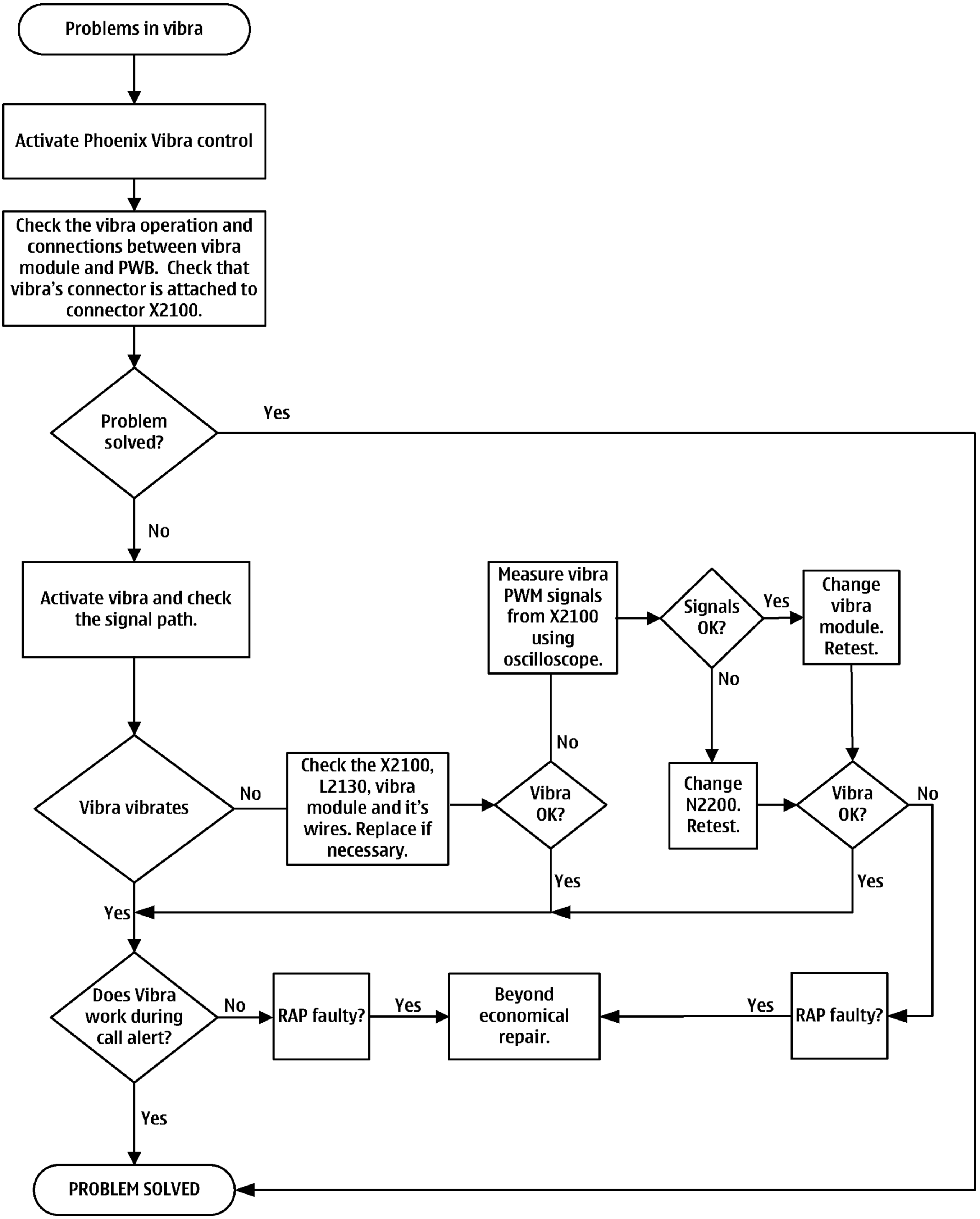
External earpiece troubleshooting

Troubleshooting flow


Problems in the external earpiece
Set Phoenix audio routing to HP_in_Ext_out mode and activate related audio parts if necessary.
Check and clean the Pop-port X2001 contacts. Replace Pop-port connector X2001 if necessary.
Problem solved?
Yes
No
Check the signal path and DC levels using Phoenix loop test according to "Test instructions" chapter
Is the output signal level and DC level as specified in "Test instructions"?
No
Check the audio path between N2200 and X2001 XEAR pads. Check L2002, L2003 and R2006. Replace if necessary.
Levels ok?
No
Yes
Change N2100. Retest.
Levels ok?
No
Yes
Change N2200. Retest.
Levels ok?
No
Yes
Yes
Does audio work during call?
No
RAP faulty?
Yes
Beyond economical repair.
Yes
RAP faulty?
Yes
PROBLEM SOLVED

Vibra troubleshooting

Troubleshooting flow


Problems in vibra
Activate Phoenix Vibra control
Check the vibra operation and connections between vibra module and PWB. Check that vibra's connector is attached to connector X2100.
Problem solved?
Yes
No
Activate vibra and check the signal path.
Measure vibra PWM signals from X2100 using oscilloscope.
Signals OK?
Yes
Change vibra module. Retest.
No
No
Vibra vibrates
No
Check the X2100, L2130, vibra module and it's wires. Replace if necessary.
Vibra OK?
Change N2200. Retest.
Vibra OK?
No
Yes
Yes
Yes
Does Vibra work during call alert?
No
RAP faulty?
Yes
Beyond economical repair.
Yes
RAP faulty?
Yes
PROBLEM SOLVED

Baseband manual tuning guide

Energy management calibration

Prerequisites

Energy Management (EM) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (that is, **battery voltage**, **BSI**, **battery current**) to get an accurate AD conversion result.

Hardware setup:

- An external power supply is needed.
- Supply 12V DC from an external power supply to CU-4 to power up the phone.
- The phone must be connected to a CU-4 control unit with a product-specific flash adapter.

Steps

1. Place the phone to the docking station adapter (CU-4 is connected to the adapter).
2. Start *Phoenix* service software.
3. Choose **File→ Scan Product.**
4. Choose **Tuning→Energy Management Calibration.**
5. To show the current values in the phone memory, click **Read**, and check that communication between the phone and CU-4 works.
6. Check that the **CU-4 used** check box is checked.
7. Select the item(s) to be calibrated.

   Note: ADC calibration has to be performed before other item(s). However, if all calibrations are selected at the same time, there is no need to perform the ADC calibration first.

8. Click **Calibrate**.

   The calibration of the selected item(s) is carried out automatically.

   The candidates for the new calibration values are shown in the *Calculated values* column. If the new calibration values seem to be acceptable (please refer to the following "Calibration value limits" table), click **Write** to store the new calibration values to the phone permanent memory.

Table 12 Calibration value limits

Parameter	Min.	Max.
ADC Offset	-20	20
ADC Gain	12000	14000
BSI Gain	1100	1300
VBAT Offset	2400	2650
VBAT Gain	19000	23000
VCHAR Gain	N/A	N/A
IBAT (ICal) Gain	7750	12250

9. Click **Read**, and confirm that the new calibration values are stored in the phone memory correctly. If the values are not stored to the phone memory, click **Write** and/or repeat the procedure again.
10. To end the procedure, close the *Energy Management Calibration* window.

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4 — RF Troubleshooting and Manual Tuning Guide

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Introduction to RF troubleshooting

All measurements should be done using:

- spectrum analyser with a low-impedance wideband passive probe (LO-/reference frequencies and RF power levels).

  Note: When measuring frequencies of 4GHz, absolute level measurements are not possible with this probe. Compare levels with a known good board.

- oscilloscope with a 10:1 probe (DC-voltages and low frequency signals)

  Caution: A mobile phone WCDMA transmitter should never be tested with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in wide area. WCDMA Tx measurements should be performed at least in an RF-shielded box and never with higher Tx power level than 0 dBm! Test full WCDMA Tx power only in RF-shielded environment.

  Also all measurements with an RF coupler should be performed in RF shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, it should be checked that there are no transmissions on the same frequencies as used in the tests.

The RF section of the phone is built around an N7500 RF ASIC with a GSM quad band dual PA , TXFEM, N7520, and a WCDMA PA, N7540.

The WCDMA PA needs a variable supply to work efficiently. This is provided by a switch mode power supply component, N7541.

Please note that the grounding of the PA module is directly below the PA module. Therefore, it is difficult to check or change the module.

Most RF semiconductors are static discharge sensitive. ESD procedures must be followed during repair, ground straps and ESD soldering irons. RF ASICs, TXFEM, PA and SMPS are moisture sensitive, so parts must be pre-baked prior to soldering.

In addition to key components, there are lot of discrete components (resistors, inductors and capacitors) which troubleshooting is done mainly by checking if the soldering of the component is done properly.

A Capacitor can be checked for shorts and resistors for value by means of an ohmmeter, but be aware, in-circuit measurements should be evaluated carefully.

Keep in mind that all measured voltages or RF levels in the service manual are rough figures. Especially RF levels vary because of different measuring equipment or different grounding of the probe used. All spectrum analyser measurements in this manual are made with a Fluke PM9639/011 10:1 (500 ohm) probe. It is recommended that a similar kind of probe is used for all troubleshooting measurements.

When using an RF probe, use a pair of metallic tweezers to connect the probe ground to the PWB ground as close to the measurement point as possible. If measurements are performed in a product specific module jig, then “GND” pads should be used for the probe ground.

RF key component placement

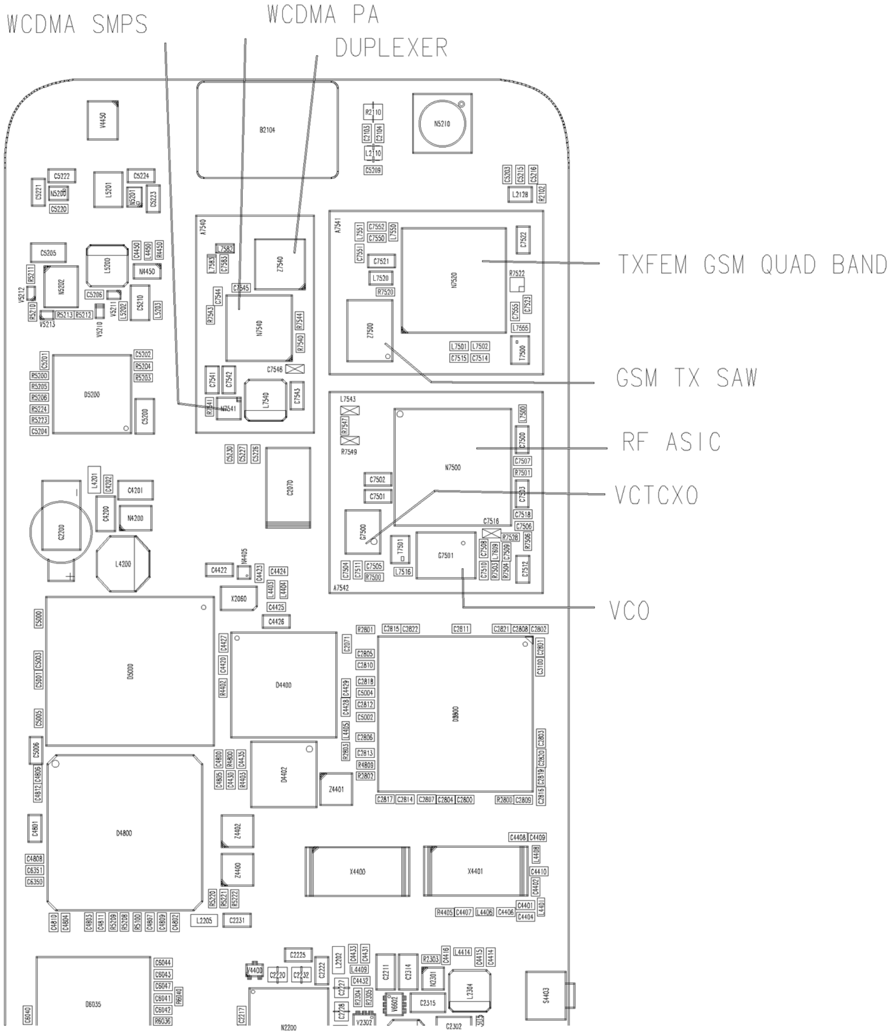

WCDMA SMPS
WCDMA PA
DUPLEXER
TXFEM GSM QUAD BAND
GSM TX SAW
RF ASIC
VCTCXO
VCO

Figure 12 RM-194 TOP

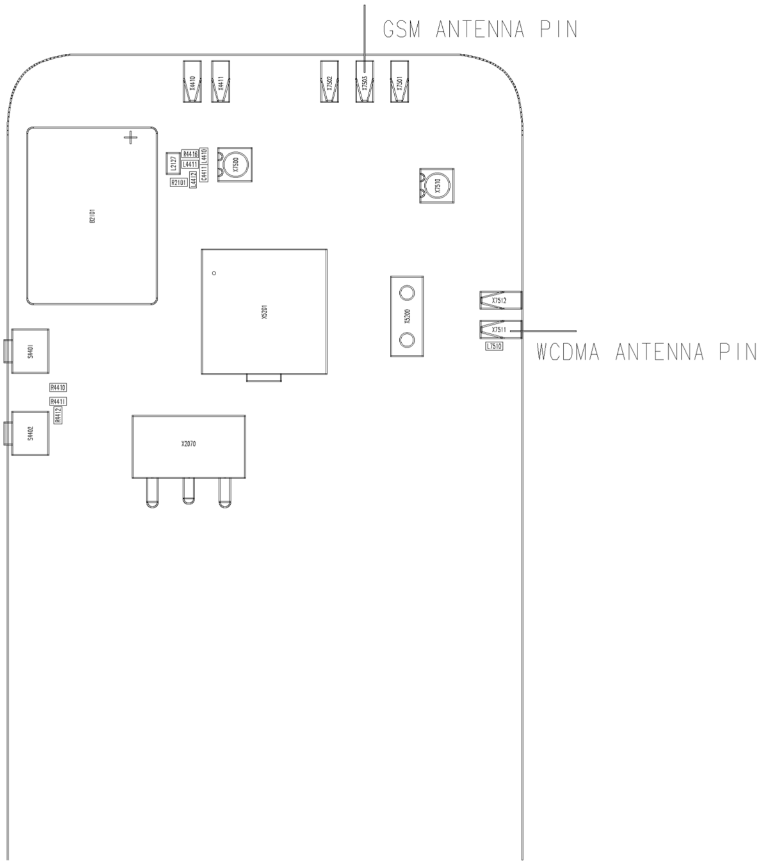
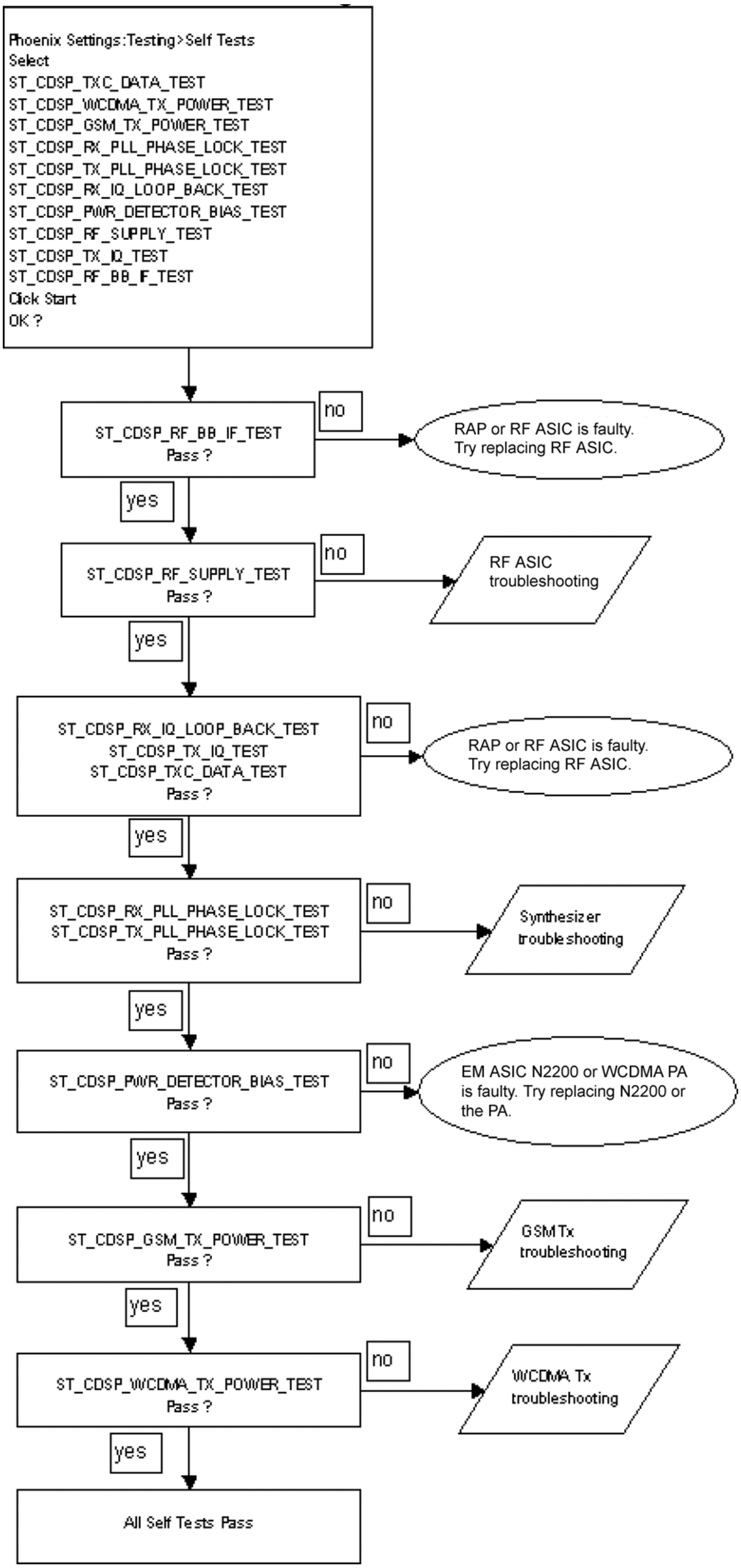

GSM ANTENNA PIN
X4410
X4411
X7502
X7503
X7501
B2101
L2127
R4416
L4411
L4410
C4411
L4412
R2101
X7500
X7510
X5201
X5200
X7512
X7511
L7510
WCDMA ANTENNA PIN
S4401
R4410
R4411
R4412
S4402
X2070

Figure 13 RM-194 BOTTOM

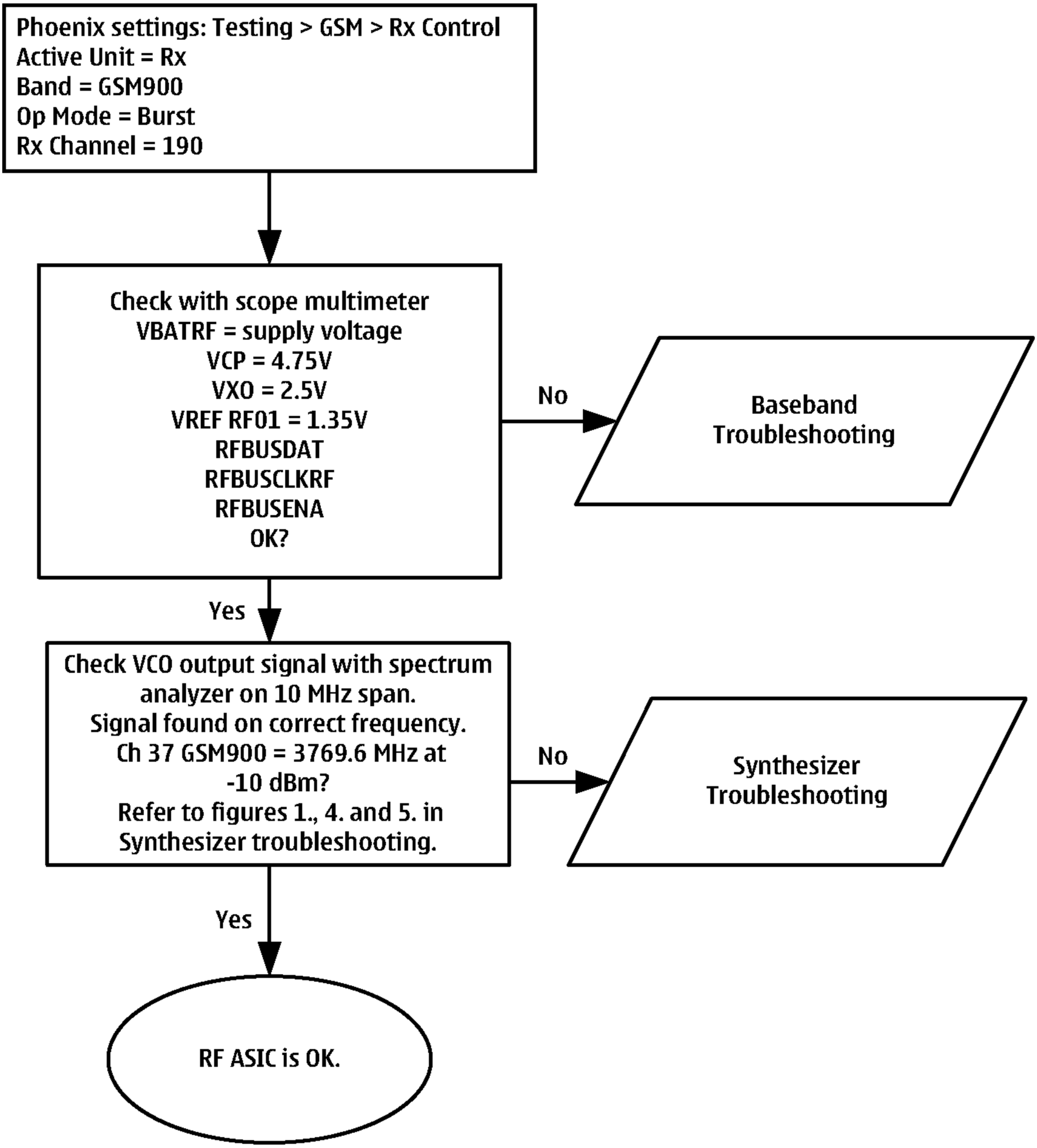
Self test troubleshooting

Troubleshooting flow


Phoenix Settings:Testing>Self Tests
Select
ST_CDSP_TXC_DATA_TEST
ST_CDSP_WCDMA_TX_POWER_TEST
ST_CDSP_GSM_TX_POWER_TEST
ST_CDSP_RX_PLL_PHASE_LOCK_TEST
ST_CDSP_TX_PLL_PHASE_LOCK_TEST
ST_CDSP_RX_IQ_LOOP_BACK_TEST
ST_CDSP_PWR_DETECTOR_BIAS_TEST
ST_CDSP_RF_SUPPLY_TEST
ST_CDSP_TX_IQ_TEST
ST_CDSP_RF_BB_IF_TEST
Click Start
OK ?
ST_CDSP_RF_BB_IF_TEST
Pass ?
no
RAP or RF ASIC is faulty.
Try replacing RF ASIC.
yes
ST_CDSP_RF_SUPPLY_TEST
Pass ?
no
RF ASIC
troubleshooting
yes
ST_CDSP_RX_IQ_LOOP_BACK_TEST
ST_CDSP_TX_IQ_TEST
ST_CDSP_TXC_DATA_TEST
Pass ?
no
RAP or RF ASIC is faulty.
Try replacing RF ASIC.
yes
ST_CDSP_RX_PLL_PHASE_LOCK_TEST
ST_CDSP_TX_PLL_PHASE_LOCK_TEST
Pass ?
no
Synthesizer
troubleshooting
yes
ST_CDSP_PWR_DETECTOR_BIAS_TEST
Pass ?
no
EM ASIC N2200 or WCDMA PA
is faulty. Try replacing N2200 or
the PA.
yes
ST_CDSP_GSM_TX_POWER_TEST
Pass ?
no
GSM Tx
troubleshooting
yes
ST_CDSP_WCDMA_TX_POWER_TEST
Pass ?
no
WCDMA Tx
troubleshooting
yes
All Self Tests Pass

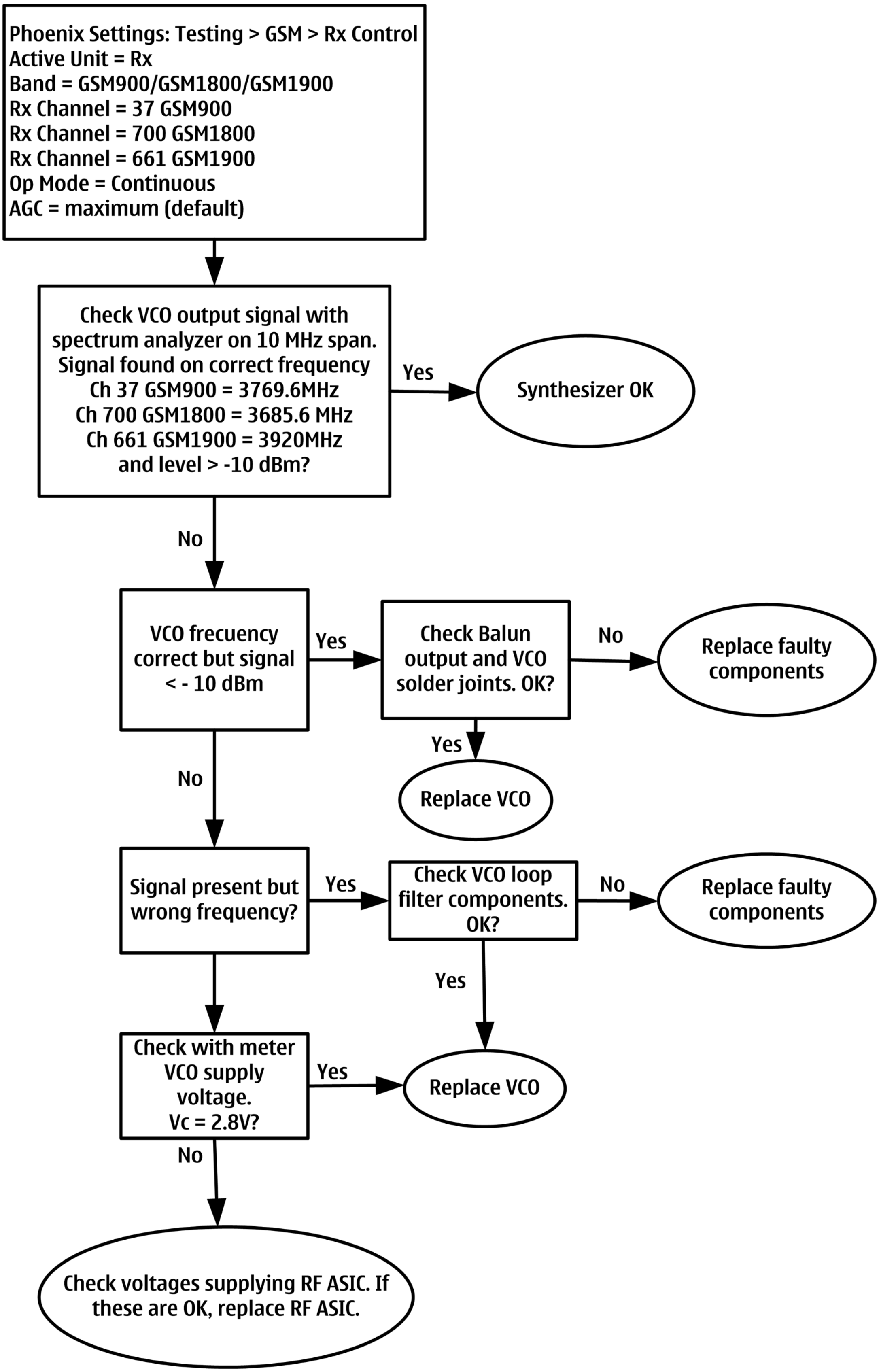
RF ASIC troubleshooting

Troubleshooting flow


Phoenix settings: Testing > GSM > Rx Control
Active Unit = Rx
Band = GSM900
Op Mode = Burst
Rx Channel = 190
Check with scope multimeter
VBATRF = supply voltage
VCP = 4.75V
VXO = 2.5V
VREF RF01 = 1.35V
RFBUSDAT
RFBUSCLKRF
RFBUSENA
OK?
No
Baseband Troubleshooting
Yes
Check VCO output signal with spectrum analyzer on 10 MHz span.
Signal found on correct frequency.
Ch 37 GSM900 = 3769.6 MHz at -10 dBm?
Refer to figures 1., 4. and 5. in Synthesizer troubleshooting.
No
Synthesizer Troubleshooting
Yes
RF ASIC is OK.

Synthesizer troubleshooting

Troubleshooting flow


Phoenix Settings: Testing > GSM > Rx Control
Active Unit = Rx
Band = GSM900/GSM1800/GSM1900
Rx Channel = 37 GSM900
Rx Channel = 700 GSM1800
Rx Channel = 661 GSM1900
Op Mode = Continuous
AGC = maximum (default)
Check VCO output signal with spectrum analyzer on 10 MHz span. Signal found on correct frequency Ch 37 GSM900 = 3769.6MHz Ch 700 GSM1800 = 3685.6 MHz Ch 661 GSM1900 = 3920MHz and level > -10 dBm?
Yes
Synthesizer OK
No
VCO frecuency correct but signal < - 10 dBm
Yes
Check Balun output and VCO solder joints. OK?
No
Replace faulty components
Yes
Replace VCO
No
Signal present but wrong frequency?
Yes
Check VCO loop filter components. OK?
No
Replace faulty components
Yes
Check with meter VCO supply voltage. Vc = 2.8V?
Yes
Replace VCO
No
Check voltages supplying RF ASIC. If these are OK, replace RF ASIC.

Synthesizer test points

Measure	RF ASIC N7500	Expected Result
VCTXCO output voltage	G7500 pin 3	38.4MHz 800 mVpp
RFCLKEXT		38.4MHz 500 mVpp
VCTXCO AFC voltage	C7505	1V

Measure	RF ASIC N7500	Expected Result
VCO	G7501	3526,4 MHz

Measure	RF ASIC N7500	Expected Result
VCO supply voltage	C7508	2.8V

Measure	RF ASIC N7500	Expected Result
VCO control voltage	C7510	1 to 3 V

RF ASIC N7500
C7510, C7512, R7503, R7504

Receiver troubleshooting

Introduction to Rx troubleshooting

Rx can be tested by making a phone call or in local mode. For the local mode testing, use the Phoenix service software.

The primary Rx troubleshooting parameter is RSSI (Received Signal Strength Indicator). For GSM RSSI measurement, see GSM Rx chain activation for manual measurements / GSM RSSI measurement (page), and for the same measurement in WCDMA, see WCDMA RSSI measurement (page 4–13).

In GSM, the input signal can be either a real GSM signal or a CW (Continuous Wave) signal, which is 67.71 kHz above the carrier frequency.

In WCDMA, the input signal can be either a real WCDMA signal or a CW signal, which is 1 MHz above the carrier frequency.

For service tool usage instructions, refer to the section **Service Tools and Service Concepts**.

Related information

- WCDMA Rx chain activation for manual measurement (page)

GSM Rx chain activation for manual measurements / GSM RSSI measurement

Context

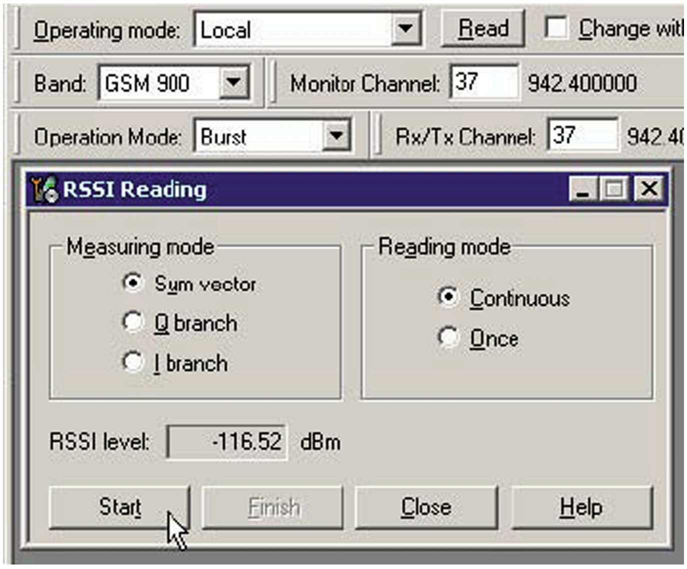
RSSI signal measurement is the main Rx troubleshooting measurement. The test measures the strength of the received signal.

I and Q branches can be measured separately. In GSM, the input signal can be either a real GSM signal or a CW (Continuous Wave) signal that is 67.71 kHz above the carrier frequency.

Steps

1. Start *Phoenix* service software.
2. Choose **Testing→GSM→RSSI Reading** .
3. Set the RF signal generator for a channel frequency +67.71 kHz in CW mode with a −80 dBm signal level.

   Alternatively set the cellular tester downlink channel to the appropriate channel. Make sure that the tester is set to continuous mode, not to burst mode.
4. In the *RSSI Reading* window, select the appropriate band and channel.



Operating mode: Local
☐ Change wit
Band: GSM 900
Monitor Channel: 37 942.400000
Operation Mode: Burst
Rx/Tx Channel: 37 942.4

RSSI Reading

Measuring mode
● Sum vector
○ Q branch
○ I branch

Reading mode
● Continuous
○ Once

RSSI level: -116.52 dBm

Figure 14 ***RSSI Reading*** **window**

5. To start the measurement, activate GSM Rx chain, click **Start**.

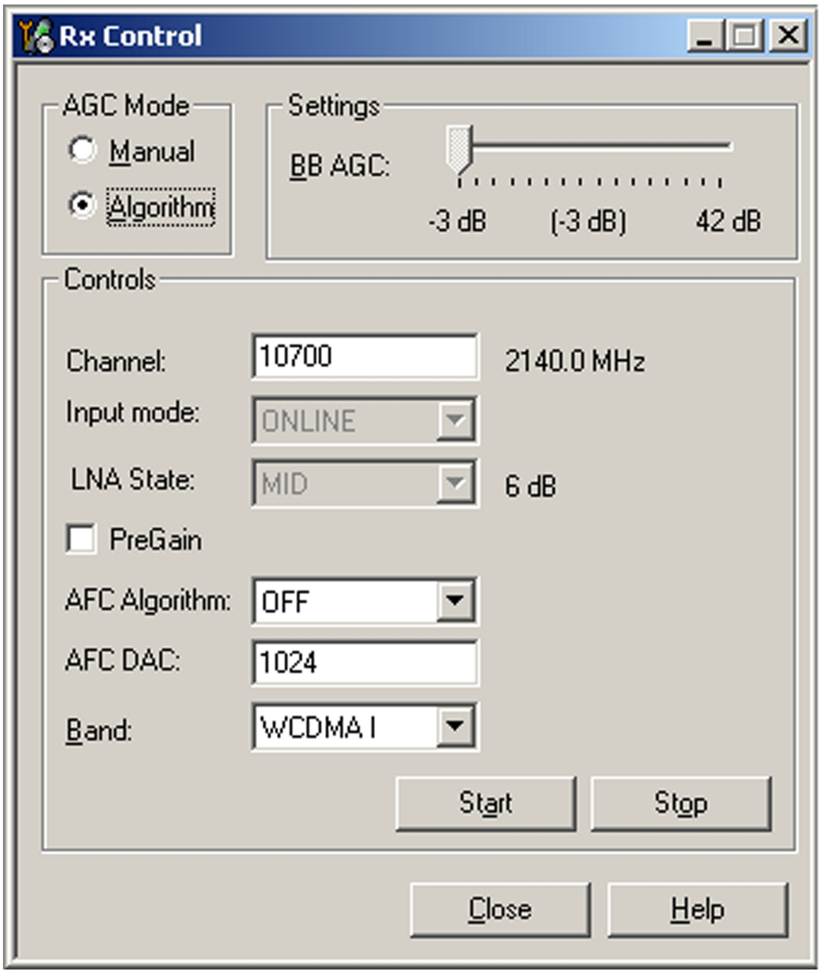
Results

RSSI reading values of the selected band and channel are displayed. The RSSI level must be the same value as that which is set at the signal generator (-80 dBm).

WCDMA Rx chain activation for manual measurement

Steps

1. Start *Phoenix* service software.
2. Choose **Testing→WCDMA→Rx Control** .
3. In the *Rx Control* window:



AGC Mode: ○ Manual ● Algorithm

BB AGC: -3 dB (-3 dB) 42 dB

Channel: 10700 2140.0 MHz

Input mode: ONLINE

LNA State: MID 6 dB

☐ PreGain

AFC Algorithm: OFF

AFC DAC: 1024

Band: WCDMA I

- Set **AGC Mode** to **Algorithm**.
- Set **Channel** to **10700**.
- Set **AFC Algorithm** to **OFF** (Default = **OFF**).

Next actions

When settings are ready, click **Start** to activate them.

If settings are changed later on (for example, you give a new channel number), you will need to click **Stop** and **Start** again.

Note: Clicking **Stop** also disables **Tx Control** if that was active!

WCDMA RSSI measurement

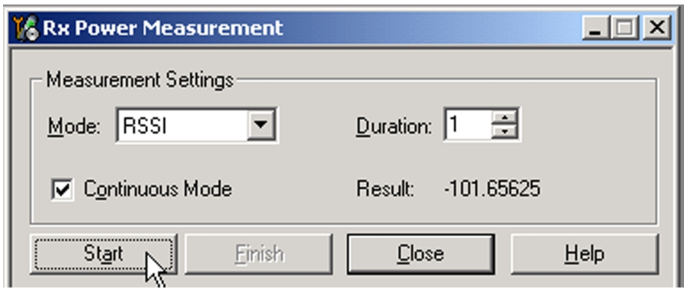
Prerequisites

WCDMA Rx must be activated before RSSI can be measured. See WCDMA Rx chain activation for manual measurement (page).

Steps

1. Start *Phoenix* service software.
2. Choose **Testing→WCDMA→Rx Power Measurement** .
3. In the *Rx Power Measurement* window, choose the following settings:
    - Mode: RSSI

- Continuous Mode



Rx Power Measurement
Measurement Settings
Start
Finish
Close
Help

Mode: RSSI

Duration: 1

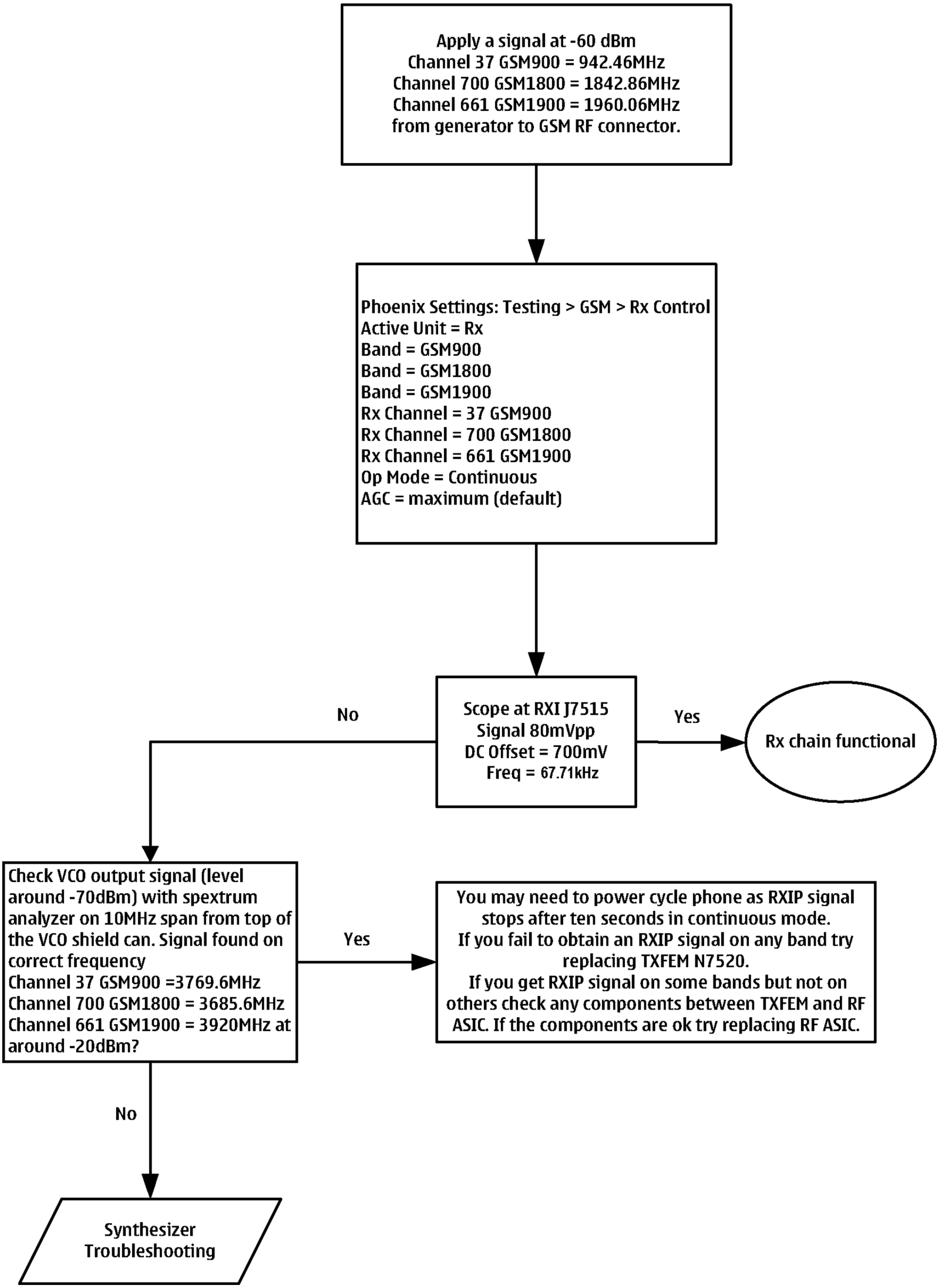
☑ Continuous Mode

Result: -101.65625

4. To perform the measurement, click **Start**.

GSM receiver troubleshooting

Troubleshooting flow



Apply a signal at -60 dBm
Channel 37 GSM900 = 942.46MHz
Channel 700 GSM1800 = 1842.86MHz
Channel 661 GSM1900 = 1960.06MHz
from generator to GSM RF connector.

Phoenix Settings: Testing > GSM > Rx Control
Active Unit = Rx
Band = GSM900
Band = GSM1800
Band = GSM1900
Rx Channel = 37 GSM900
Rx Channel = 700 GSM1800
Rx Channel = 661 GSM1900
Op Mode = Continuous
AGC = maximum (default)

Scope at RXI J7515
Signal 80mVpp
DC Offset = 700mV
Freq = 67.71kHz

Rx chain functional

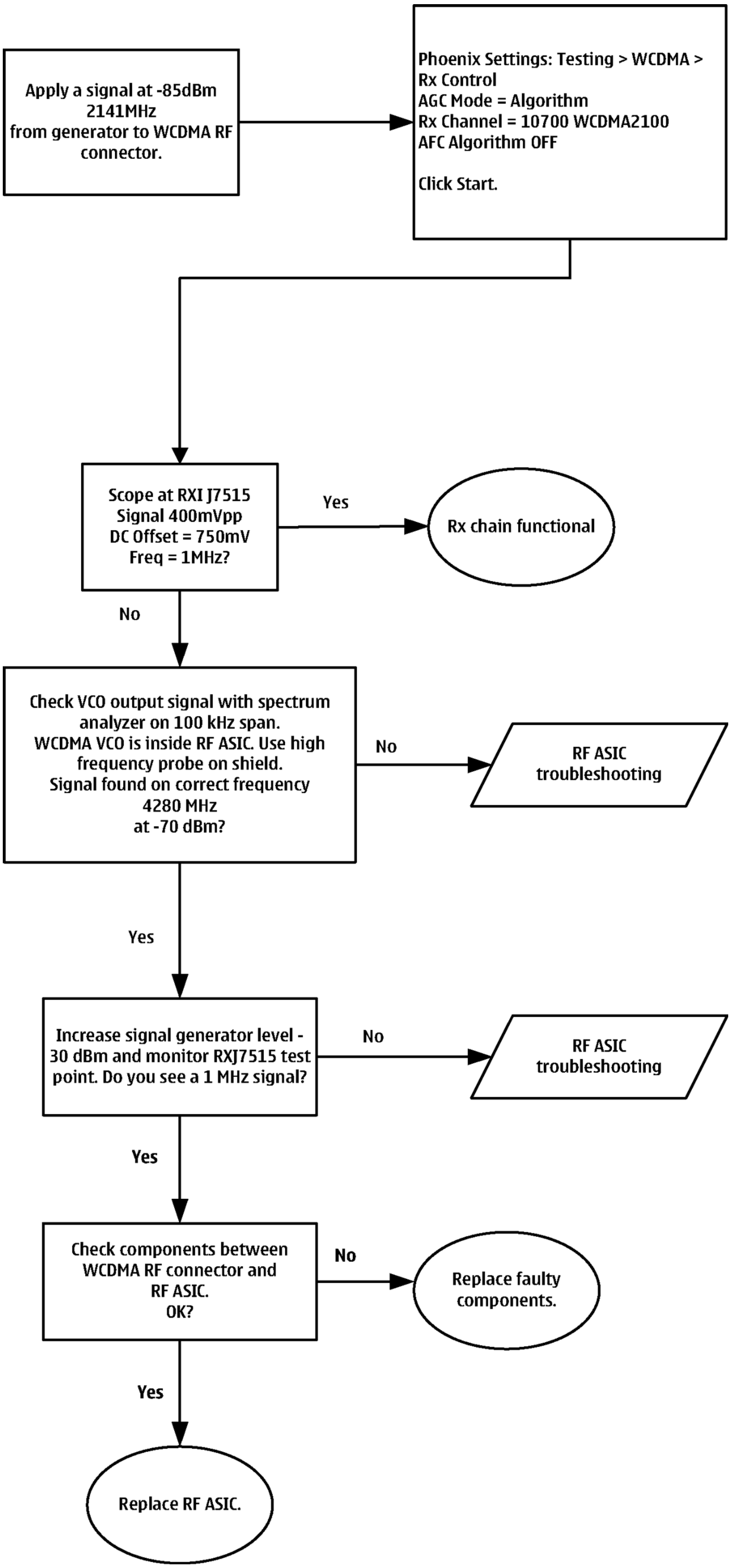
Check VCO output signal (level around -70dBm) with spextrum analyzer on 10MHz span from top of the VCO shield can. Signal found on correct frequency
Channel 37 GSM900 =3769.6MHz
Channel 700 GSM1800 = 3685.6MHz
Channel 661 GSM1900 = 3920MHz at around -20dBm?

You may need to power cycle phone as RXIP signal stops after ten seconds in continuous mode.
If you fail to obtain an RXIP signal on any band try replacing TXFEM N7520.
If you get RXIP signal on some bands but not on others check any components between TXFEM and RF ASIC. If the components are ok try replacing RF ASIC.

Synthesizer Troubleshooting

WCDMA receiver troubleshooting

Troubleshooting flow


Apply a signal at -85dBm 2141MHz from generator to WCDMA RF connector.
Phoenix Settings: Testing > WCDMA > Rx Control
AGC Mode = Algorithm
Rx Channel = 10700 WCDMA2100
AFC Algorithm OFF
Click Start.
Scope at RXI J7515 Signal 400mVpp DC Offset = 750mV Freq = 1MHz?
Yes
Rx chain functional
No
Check VCO output signal with spectrum analyzer on 100 kHz span. WCDMA VCO is inside RF ASIC. Use high frequency probe on shield. Signal found on correct frequency 4280 MHz at -70 dBm?
No
RF ASIC troubleshooting
Yes
Increase signal generator level - 30 dBm and monitor RXJ7515 test point. Do you see a 1 MHz signal?
No
RF ASIC troubleshooting
Yes
Check components between WCDMA RF connector and RF ASIC. OK?
No
Replace faulty components.
Yes
Replace RF ASIC.

Receiver test points

Measure	RF ASIC N7500	Expected Result
RXIP	J7515	400 mVpp and 700mVDC
RXIN		400 mVpp and 700mVDC
RXQP	J7517	400 mVpp and 700mVDC
RXQN		400 mVpp and 700mVDC

Band	RF ASIC 7500	Expected Result
GSM900	No test point	942,46771 MHz at 50dBm
GSM1800	C7515	1842,86771 MHz at 50dBm
GSM1900	C7514	1960,06771 MHz at 50dBm

■ Transmitter troubleshooting

General instructions for Tx troubleshooting

Context

- Tx troubleshooting requires Tx operation.
- Do not transmit on frequencies that are in use.
- Transmitter can be controlled in the local mode for diagnostic purposes.
- The best diagnostic tool for GSM transmitter testing is **RF Controls**, and for the WCDMA transmitter testing **Tx Control**.

  Tx IQ tuning and Tx power tuning can be also used in some cases.
- Remember that retuning is not a repair procedure.

The first set of steps instructs how to assemble the test setup. This setup is general for all Tx troubleshooting tasks.

Alternative steps provide specific troubleshooting instructions for *Phoenix* service software. The first section is for the EGSM900/GSM1800/GSM1900 bands and the latter for WCDMA.

> **Caution:** Never activate the GSM or WCDMA transmitter without a proper antenna load. There should be always 50 ohm load connected to the RF connector (antenna, RF-measurement equipment or at least 2 watts dummy load), otherwise GSM or WCDMA PA may be damaged.

Steps

1. Connect a module jig to a computer with a DAU-9S cable or to a FPS-10 flash prommer with a modular cable.

   Make sure that you have a PKD-1 dongle connected to the computer parallel port.
2. Connect a DC power supply to a product-specific module jig.

> **Note:** When repairing or tuning a transmitter, use an external DC supply with at least 3 A current capability.

Set the DC supply voltage to 3.9 V.

3. Connect an RF cable between the RF connector of the product-specific module test jig and measurement equipment or alternatively use a 50 ohms (at least 2 W) dummy load in the module test jig RF connector; otherwise GSM or WCDMA PA may be damaged.

   Note: There are three antenna connectors in the module jig:

   - one for GSM
   - one for WCDMA
   - one for Bluetooth

   Make sure that all connections are made to the correct RF connector.

   Normally a spectrum analyser is used as measurement equipment.

   Note: The maximum input power of a spectrum analyser is +30 dBm.

   To prevent any damage, it is recommended to use 10 dB attenuator on the spectrum analyzer input.

4. Set Tx on.

   i Place the phone module to the test jig and start *Phoenix* service software.

   ii Initialize connection to the phone (with FPS-10 use FBUS when using a DAU-9S cable and a COMBOX driver).

   iii Choose **File**→**Open Product**→**xx-x*** (* = type designator of the phone) or **File**→**Scan Product.** .

   iv From the toolbar, set **Operating mode** to **Local.**

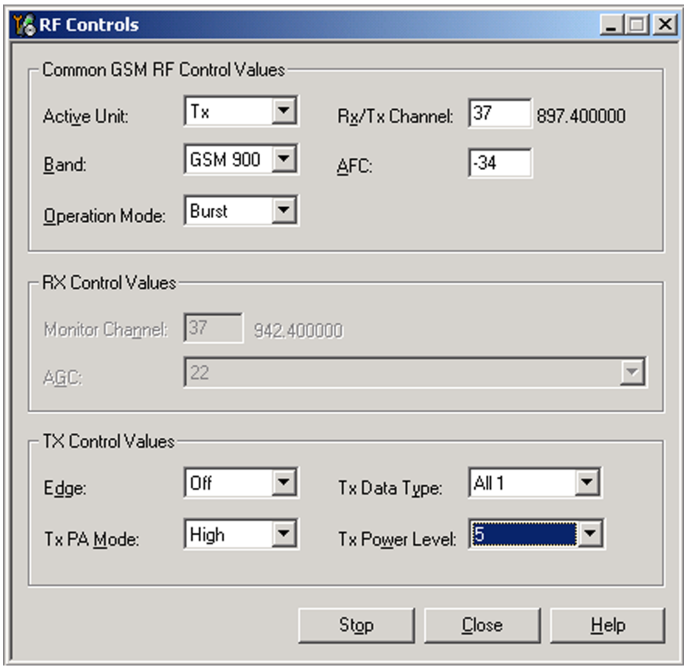
Alternative steps

- EGSM900/GSM1800/GSM1900 troubleshooting

  i Choose **Testing**→**GSM**→**RF Controls.**

  ii In the *RF Controls* window:

  - Choose **Band**: **GSM900** or **GSM1800** or **GSM1900** (Default = **GSM900**).
  - Set **Rx/Tx channel** in the following way:
    - GSM900: **37**
    - GSM1800: **700**
    - GSM1900: **661**
  - Set **Active unit** to **Tx** (Default = **Rx**).
  - Set **Operation Mode** to **Burst** (Default = **Burst**).
  - Set **Edge** to **Off** (Default).
  - Set **Tx Data Type** to **All 1** (Default = **All 1**).
  - Set **Tx PA Mode** to **High** (Default).
  - Set **Tx Power Level** in the following way:
    - GSM900: **5** (Default = **19**)
    - GSM1800: **0** (Default = **15**)
    - GSM1900: **0** (Default = **15**)


RF Controls
Common GSM RF Control Values
RX Control Values
TX Control Values
Stop
Close
Help

Active Unit: Tx
Rx/Tx Channel: 37 897.400000
Band: GSM 900
AFC: -34
Operation Mode: Burst
Monitor Channel: 37 942.400000
AGC: 22
Edge: Off
Tx Data Type: All 1
Tx PA Mode: High
Tx Power Level: 5

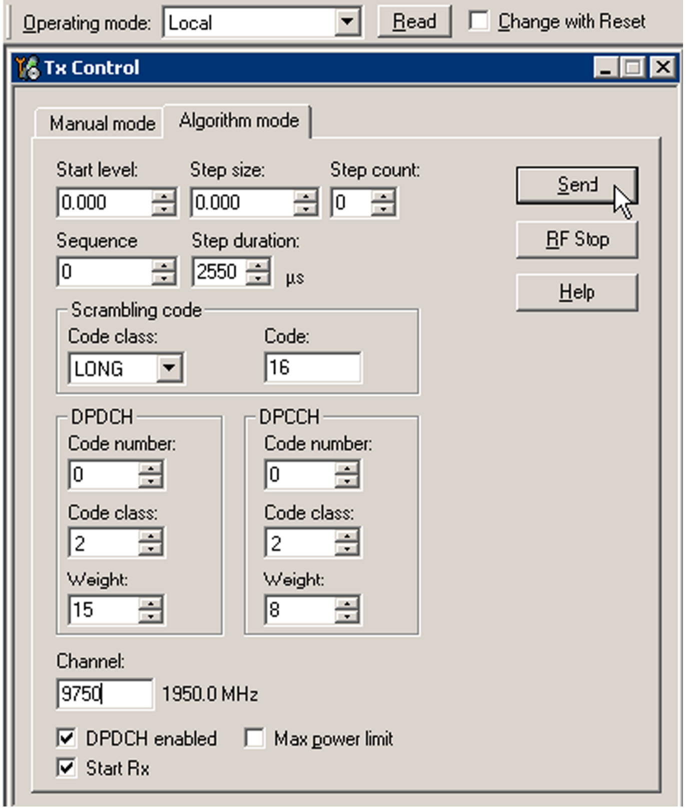
Figure 15 ***RF Controls*** **window**

- WCDMA troubleshooting

  i Choose **Testing→WCDMA→Tx Control.**

  ii In the *Tx Control* window:

  - Select the **Algorithm mode** tab.
  - Set **Start level** to **0** dBm (Default = **0**).
  - Set **Step size**, **Step count** and **Sequence** to **0** (Default = **0**).
  - In the **Scrambling code** pane set **Code class** to **LONG** (Default = **LONG**), and **Code** to **16** (Default = **16**).
  - For **DPDCH** set the following values:
    - **Code number**: **0**
    - **Code class**: **2**
    - **Weight**: **15**
  - For **DPCCH** set the following values:
    - **Code number**: **0**
    - **Code class**: **2**
    - **Weight**: **8**
  - Set **Channel** to **9750**.
  - Check the **DPDCH enabled** check box (Default).



Operating mode: Local
☐ Change with Reset

Start level: 0.000
Step size: 0.000
Step count: 0
Sequence 0
Step duration: 2550 µs

Scrambling code
Code class: LONG
Code: 16

DPDCH
Code number: 0
Code class: 2
Weight: 15

DPCCH
Code number: 0
Code class: 2
Weight: 8

Channel: 9750 1950.0 MHz

☑ DPDCH enabled ☐ Max power limit
☑ Start Rx

Figure 16 *Tx Control* window

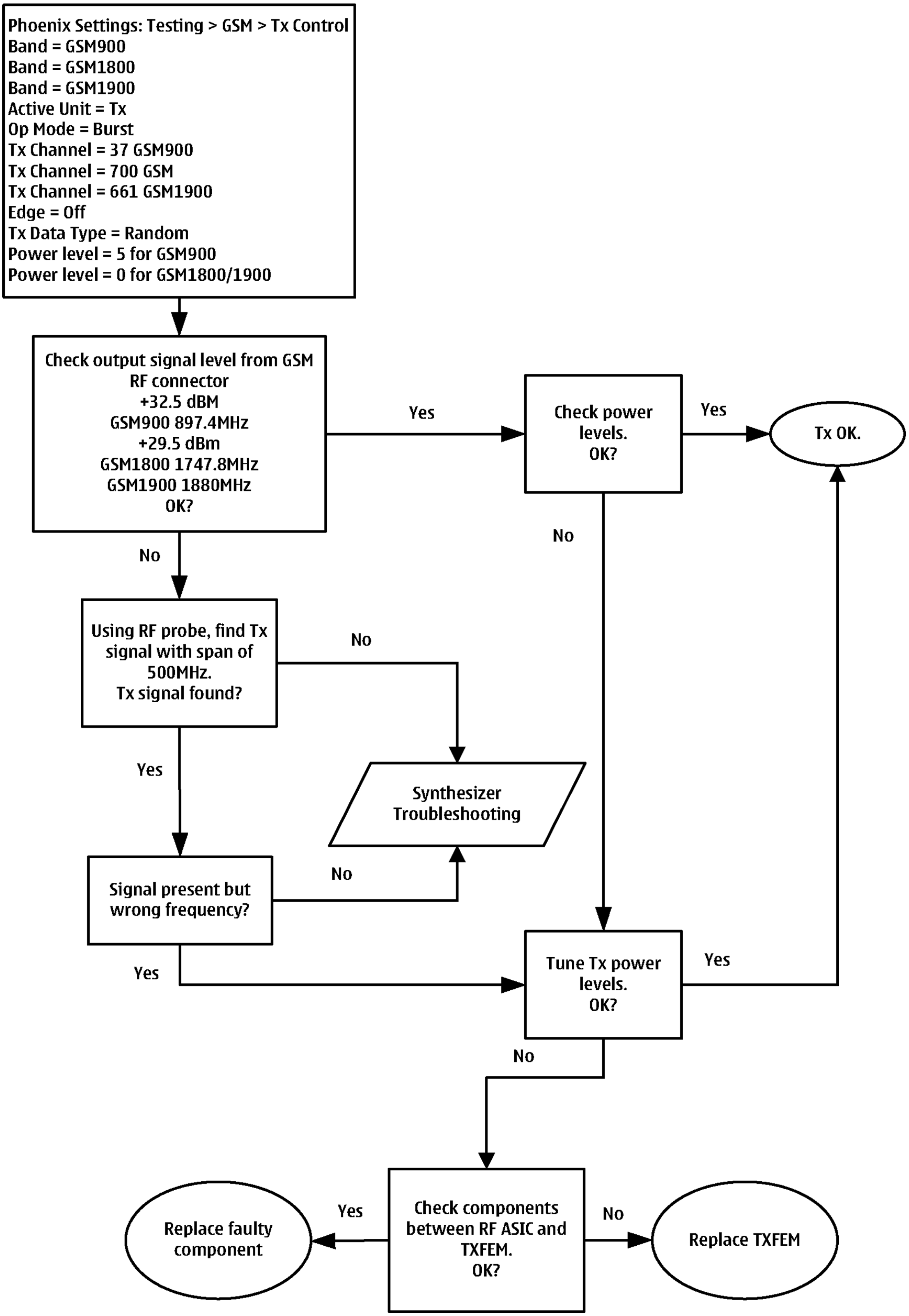
Next actions

When settings are done, click **Send** to enable them.

If you change the settings (e.g. give a new channel number), you need to click **Stop** and **Send** again.

GSM transmitter troubleshooting

Troubleshooting flow

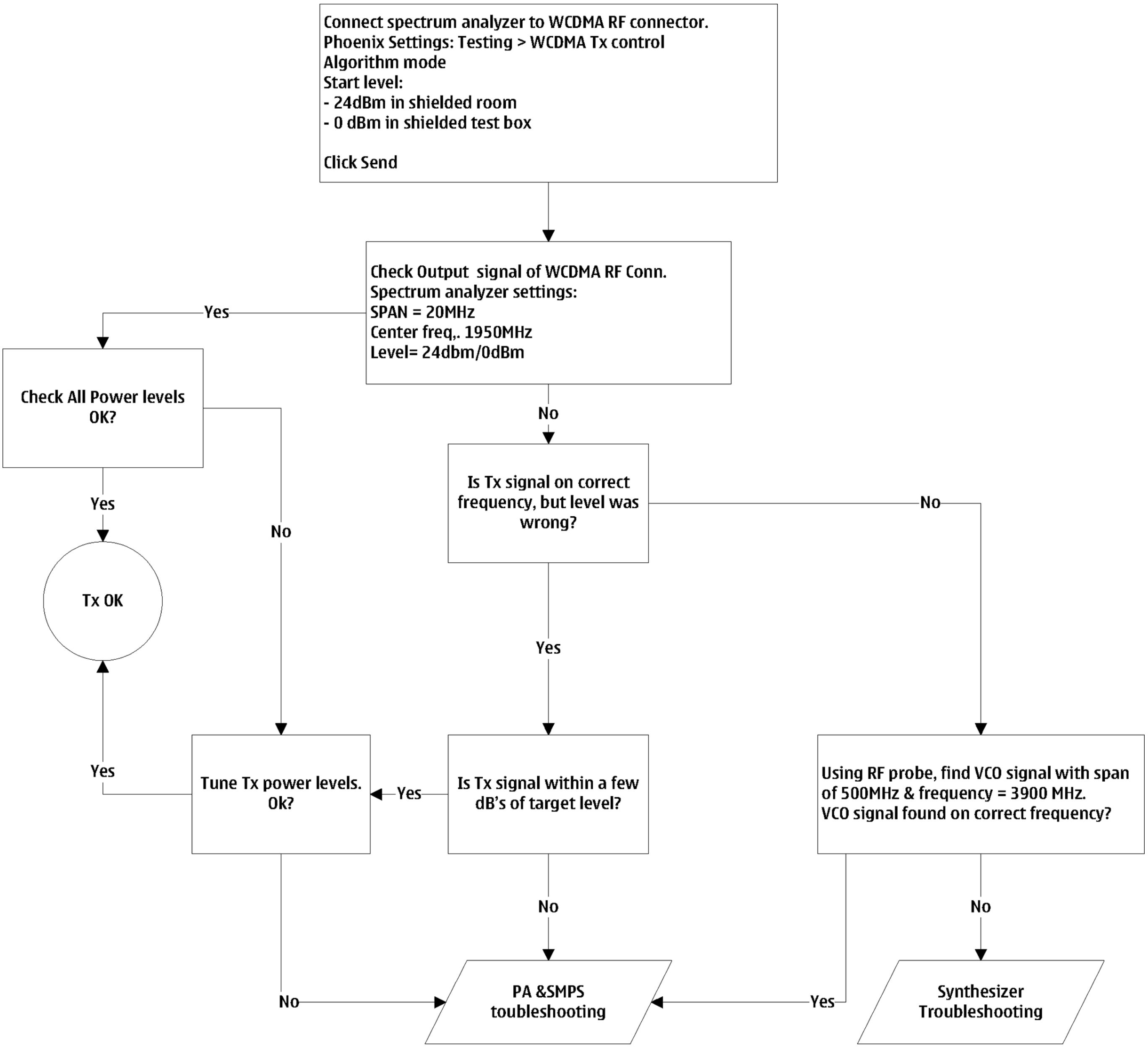


Phoenix Settings: Testing > GSM > Tx Control
Band = GSM900
Band = GSM1800
Band = GSM1900
Active Unit = Tx
Op Mode = Burst
Tx Channel = 37 GSM900
Tx Channel = 700 GSM
Tx Channel = 661 GSM1900
Edge = Off
Tx Data Type = Random
Power level = 5 for GSM900
Power level = 0 for GSM1800/1900

Check output signal level from GSM RF connector
+32.5 dBM
GSM900 897.4MHz
+29.5 dBm
GSM1800 1747.8MHz
GSM1900 1880MHz
OK?
Yes
Check power levels.
OK?
Yes
Tx OK.
No
No
Using RF probe, find Tx signal with span of 500MHz.
Tx signal found?
No
Yes
Synthesizer Troubleshooting
Signal present but wrong frequency?
No
Yes
Tune Tx power levels.
OK?
Yes
No
Replace faulty component
Yes
Check components between RF ASIC and TXFEM.
OK?
No
Replace TXFEM

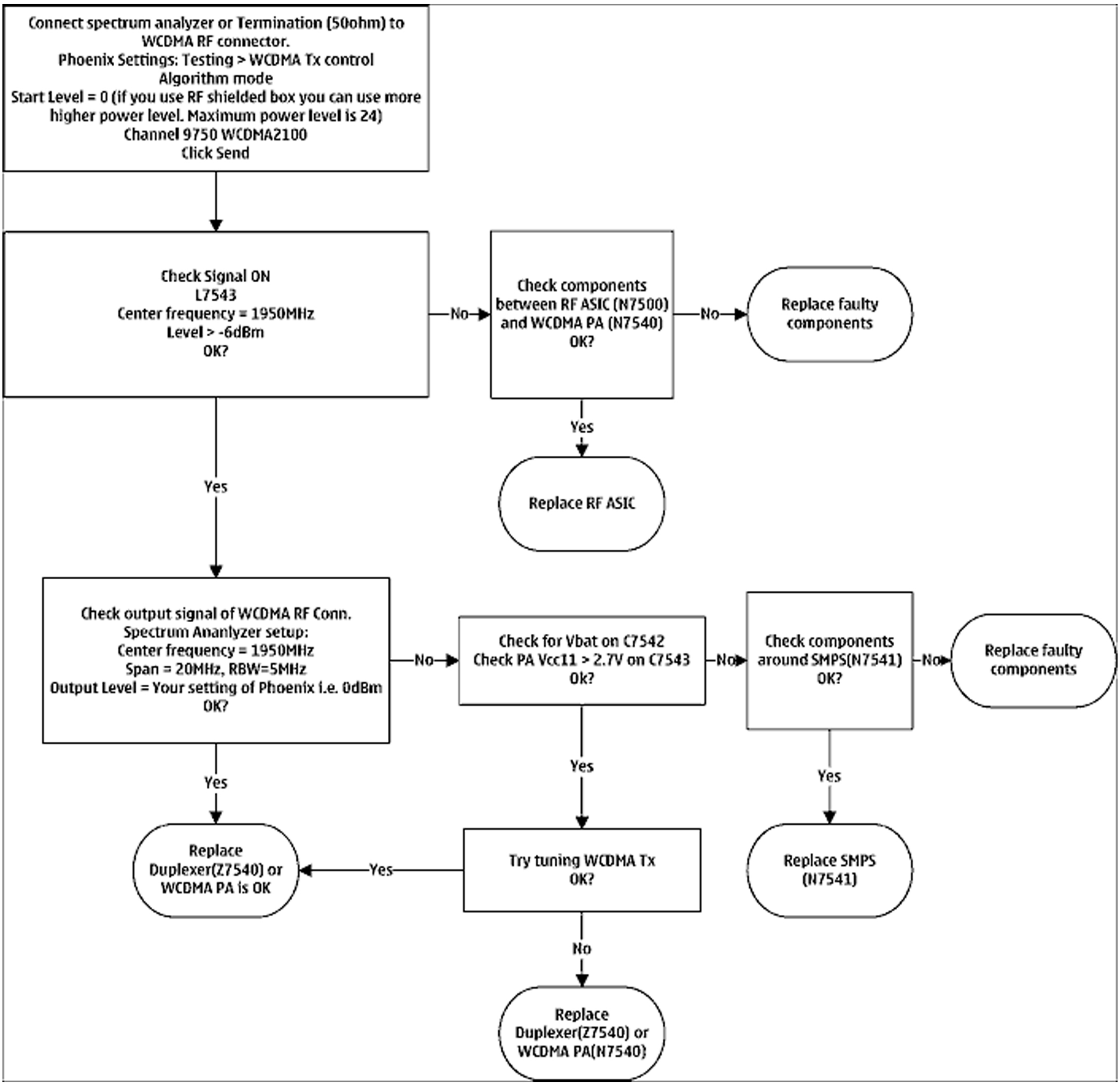
WCDMA transmitter troubleshooting

Troubleshooting flow


Connect spectrum analyzer to WCDMA RF connector.
Phoenix Settings: Testing > WCDMA Tx control
Algorithm mode
Start level:
- 24dBm in shielded room
- 0 dBm in shielded test box
Click Send
Check Output signal of WCDMA RF Conn.
Spectrum analyzer settings:
SPAN = 20MHz
Center freq,. 1950MHz
Level= 24dbm/0dBm
Yes
Check All Power levels OK?
No
Yes
Tx OK
Is Tx signal on correct frequency, but level was wrong?
No
Yes
Using RF probe, find VCO signal with span of 500MHz & frequency = 3900 MHz.
VCO signal found on correct frequency?
Yes
Tune Tx power levels. Ok?
Yes
Is Tx signal within a few dB's of target level?
No
No
No
PA &SMPS toubleshooting
Yes
Synthesizer Troubleshooting

Power amplifier (PA) and switch mode power supply (SMPS) troubleshooting

Troubleshooting flow


Connect spectrum analyzer or Termination (50ohm) to WCDMA RF connector.
Phoenix Settings: Testing > WCDMA Tx control Algorithm mode
Start Level = 0 (if you use RF shielded box you can use more higher power level. Maximum power level is 24)
Channel 9750 WCDMA2100
Click Send
Check Signal ON L7543 Center frequency = 1950MHz Level > -6dBm OK?
No
Check components between RF ASIC (N7500) and WCDMA PA (N7540) OK?
No
Replace faulty components
Yes
Replace RF ASIC
Yes
Check output signal of WCDMA RF Conn. Spectrum Ananlyzer setup: Center frequency = 1950MHz Span = 20MHz, RBW=5MHz Output Level = Your setting of Phoenix i.e. 0dBm OK?
No
Check for Vbat on C7542 Check PA Vcc11 > 2.7V on C7543 OK?
No
Check components around SMPS(N7541) OK?
No
Replace faulty components
Yes
Replace SMPS (N7541)
Yes
Try tuning WCDMA Tx OK?
Yes
Replace Duplexer(Z7540) or WCDMA PA is OK
No
Replace Duplexer(Z7540) or WCDMA PA(N7540)
Yes

RF tunings

Introduction to RF tunings

Phone RF is tuned in production. There is no reason to do the re-calibration unless:

- One or more of the RF components is changed
- FLASH memory chip (D5000) is changed or otherwise corrupted.

Note: RF calibration is always performed with the help of a product-specific module jig, never with an RF coupler. Using an RF coupler in the calibration phase will cause a complete mistuning of the RF side.

Important: After RF component changes, **always** use autotuning. Manual tunings are only required in rare cases.

Cable and adapter losses

RF cables and adapters have some losses. They have to be taken into account when the phone is tuned. As all the RF losses are frequency dependent, the user have to be very careful and understand the measurement setup. The following table presents the RF attenuations of the product-specific module jig:

Band	Attenuation
GSM900	0.25dB
GSM1800	0.4dB
GSM1900	0.45dB
WCDMA 2100	0.2dB

RF autotuning

Prerequisites

For information on the recommended test set-up, refer to the corresponding information on the Partner Website or Nokia Online.

Before you can use the autotuning feature, the GPIB driver from the GPIB card vendor must be installed and running.

The autotune **.xml** file must be in a correct place: **C:\Program Files\Nokia\Phoenix\products\xx-x*\rfconf_xx-x*.xml** (**= indicates the type designator of the phone, e.g. RM-1*)

Context

RF autotuning is performed with the aid of a digital radio communication tester.

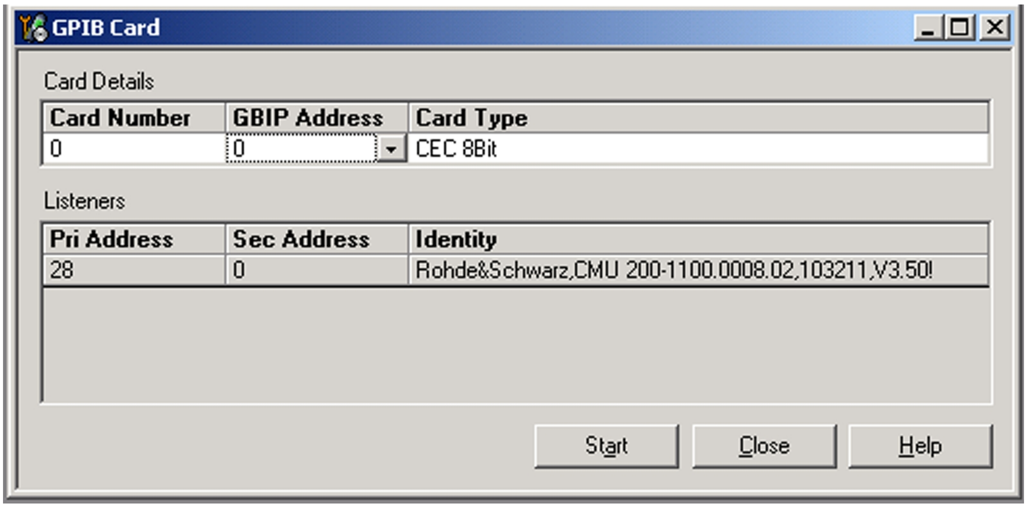
Autotuning covers all RF tunings that need to be performed after RF component repairs.

Note: Do not perform RF autotuning without a proper reason. Autotuning may only be performed after component repairs or if the RF tuning information is lost.

Steps

1. Connect the communication tester to the GPIB bus.
2. Start *Phoenix* service software.
3. Choose **Tools→Options→GPIB Card.**
4. From the **Card Type** drop-down menu, choose the GPIB card used, then click **Start**.

   The name of the communication tester appears in the **Listeners** pane.



Card Details

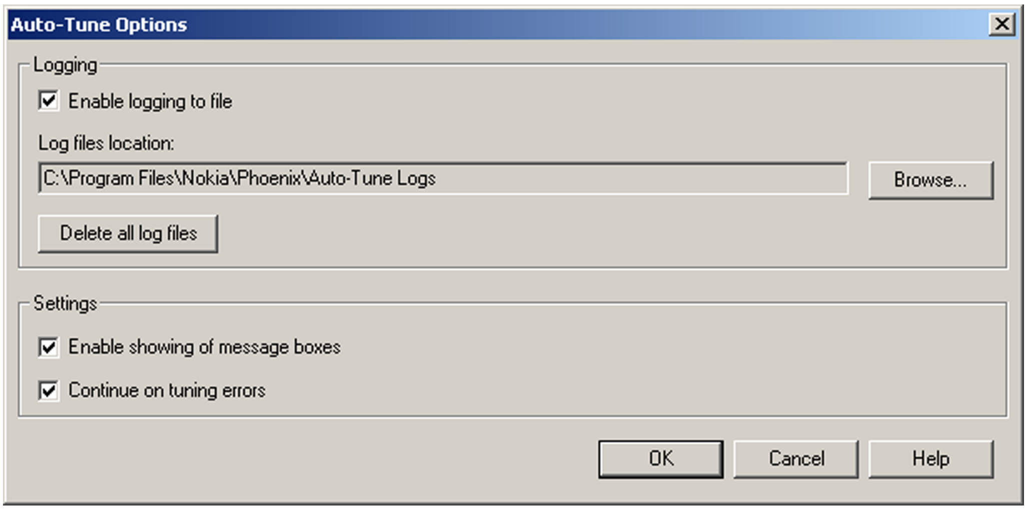
Card Number	GBIP Address	Card Type
0	0	CEC 8Bit

Listeners

Pri Address	Sec Address	Identity
28	0	Rohde&Schwarz,CMU 200-1100.0008.02,103211,V3.50!

5. To specify the cable loss from a module jig to the communication tester, choose **Set Loss** from the **Tuning** menu.
6. In the *Set Loss* window, click the **Jig** tab, and select the right jig for the phone from the drop-down list.

   Alternatively, you can add a new jig by clicking **Add**, and selecting the desired jig from the list.
7. Click the **Cable** tab and add the extra cable attenuation.
8. To start autotuning, choose **Auto-Tune** from the **Tuning** menu.
9. In the *Auto-Tune* window, click **Options**.
10. In the *Auto-Tune options* window, ensure the **Enable showing of message boxes** check box is checked, and click **OK**.



Logging

☑ Enable logging to file

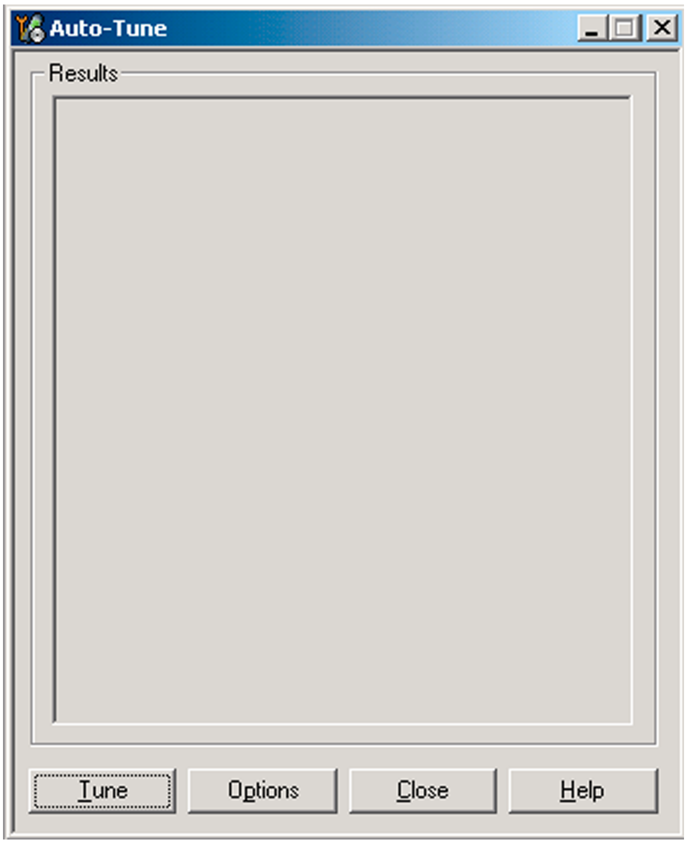
Log files location: C:\Program Files\Nokia\Phoenix\Auto-Tune Logs

Settings

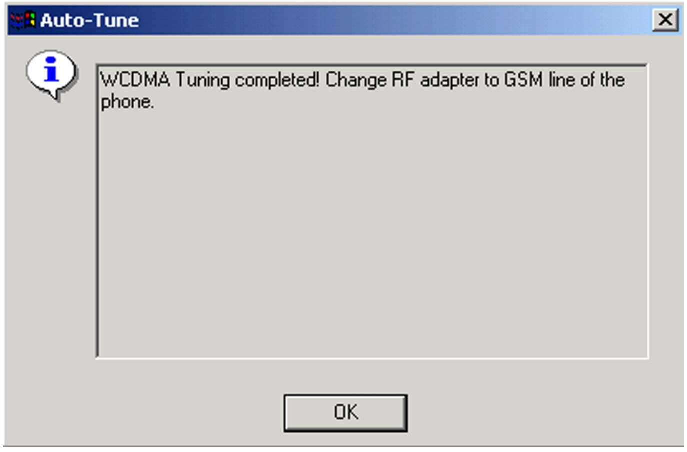
☑ Enable showing of message boxes

☑ Continue on tuning errors

11. Connect the phone WCDMA RF port to the communication tester, and click **Tune**.


Auto-Tune
Results
Tune
Options
Close
Help

12. Change the phone RF adapter from WCDMA port to GSM port.

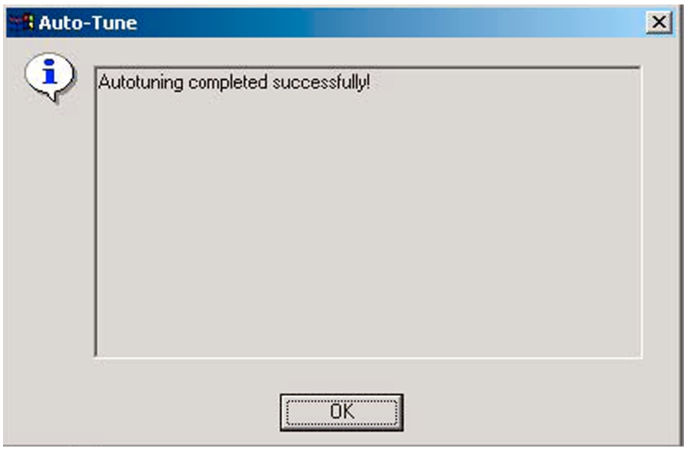

Auto-Tune
OK

WCDMA Tuning completed! Change RF adapter to GSM line of the phone.

13. To complete the RF autotuning, click **OK**.

Results

Autotuning completed successfully! message appears.



Autotuning completed successfully!

RF manual tuning guide

Required manual tunings after component changes

Important: After RF component changes, **always** use autotuning. Manual tunings are only required in rare cases.

If, however, manual tuning is used, only relevant tunings should be performed. Refer to the following table:

Changed component	Perform the following tunings
RF ASIC N7500	RF Channel Filter Calibration, Temperature Sensor Calibration, Rx calibration (GSM), Rx band filter response compensation (GSM), TxIQ Tuning (GSM), Tx Power Level Tuning (GSM), Rx calibration (WCDMA), Tx AGC & Power Detector (WCDMA), Tx Band Response Calibration (WCDMA), Tx LO Leakage (WCDMA)
Any component in the GSM TX RF chain before the PA	Tx IQ Tuning, Tx Power Level Tuning
Any component in the GSM TX RF chain after the PA or PA	Tx Power Level Tuning
Any component in the WCDMA TX RF chain before the PA	Tx AGC & Power Detector, Tx Band Response Calibration, Tx LO Leakage
Any component in the WCDMA TX RX chain after the PA, PA, power detector or PA switch mode power supply	Tx AGC & Power Detector, Tx Band Response Calibration, PA Detection
Any component in the GSM RX chain	Rx Calibration, RX Band Filter Response Compensation
Any component in the WCDMA RX chain	Rx AGC Alignment, RX Band Response Calibration
VCTCXO G7500	Rx Calibration (GSM900 band)

System mode independent manual tunings

RF channel filter calibration

Context

RF channel filter calibration tunes RF ASIC's internal low pass filters that limit the bandwidth of BB IQ signals. One common calibration is made for GSM and WCDMA.

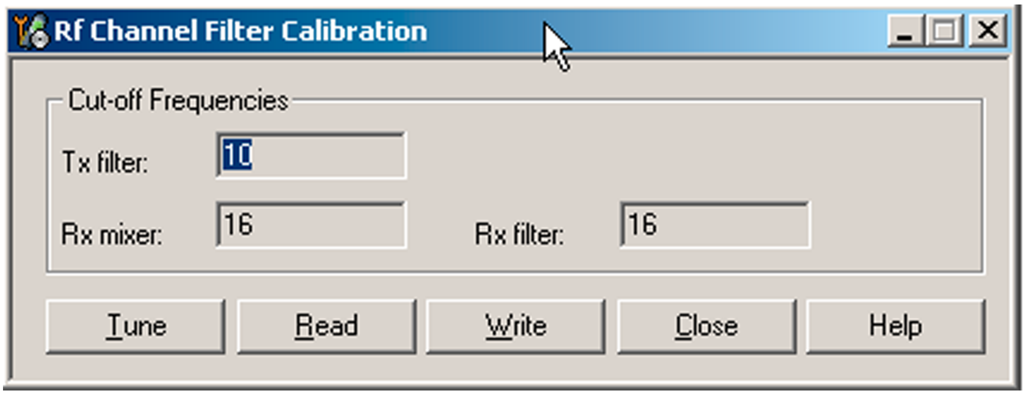
Table 13 RF channel filter calibration tuning limits

	Min	Typ	Max
Tx filter	0	10	31
Rx filter	0	16	31

Steps

1. From the "Operating mode" dropdown menu, set mode to "Local".
2. From the Tuning menu, choose "RF Channel Filter Calibration".
3. Click Tune.
4. To save the values to the PMM (Permanent Memory) area, click Write.
5. To close the tuning window, click Close.

Results



Tx filter: 10
Rx mixer: 16
Rx filter: 16

Figure 17 RF channel filter calibration typical values

PA (power amplifier) detection

Context

The PA detection procedure detects which PA manufacturer is used for phone PAs.

If a PA is changed or if the permanent memory (PMM) data is corrupted, PA detection has to be performed before Tx tunings.

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning→PA Detection** .
3. Click **Tune**.

4. Check that the detected PA manufacturers are corresponding to the actual chips on the board.
5. To end the procedure, click **Close**.

Temperature sensor calibration

Context

There is a temperature sensor intergrated into the RF ASIC. The RF ASIC produces a DC-voltage, which is temperature dependent.

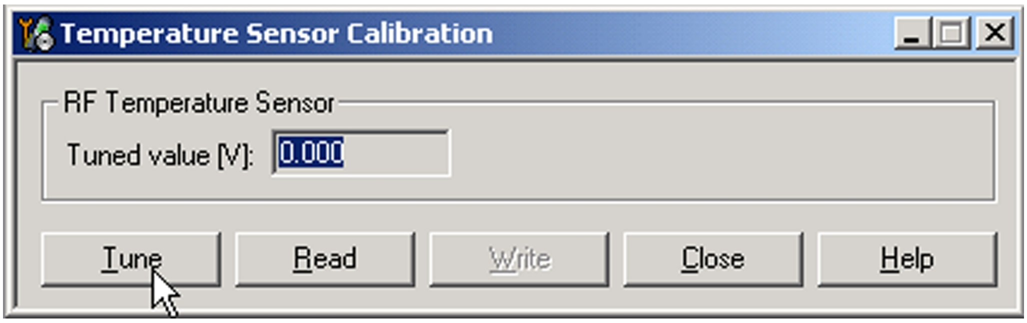
Temperature sensor calibration is done in room temperature, in which offsets caused by variations with Rx/Tx ASIC and the AD-converter inside EM ASIC N2200, are removed.

The engine calibrates itself, no external equipment is required.

The temperature of the engine must be 23°C plus or minus two degrees.

Steps

1. From the "Operating mode" dropdown menu, set mode to "Local".
2. From the Tuning menu, choose "Temperature Sensor Calibration".
3. Click "Tune".



Tuned value [V]: 0.000

Table 14 Temperature sensor calibration tuning limits

Min	Typ	Max	Unit
-60	-4	60	V

4. To save the calibration values, click "Write".
5. To finish the calibration, click "Close".

GSM receiver tunings

Rx calibration (GSM)

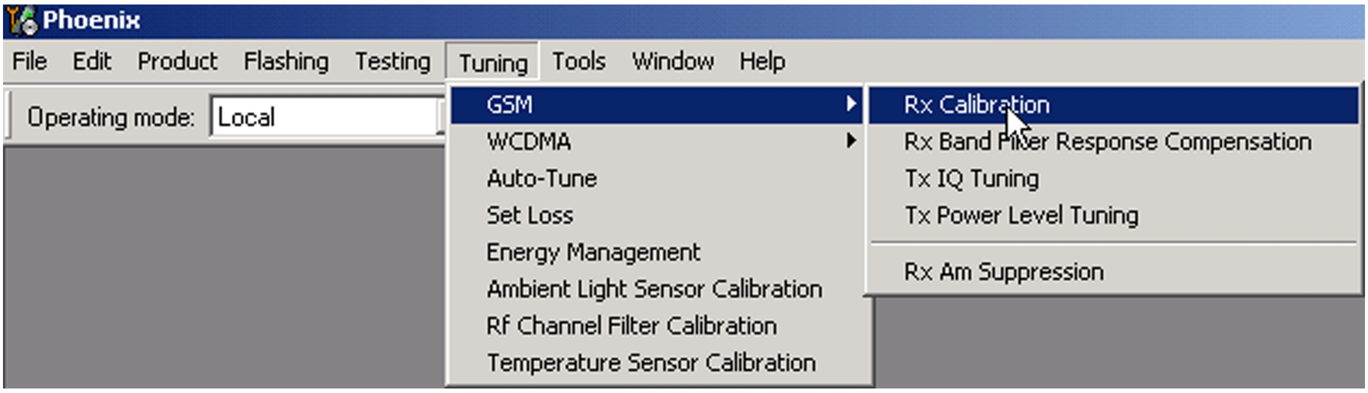
Context

Rx Calibration is used to find out the real gain values of the GSM Rx AGC system and tuning response of the AFC system (AFC D/A init value and AFC slope)

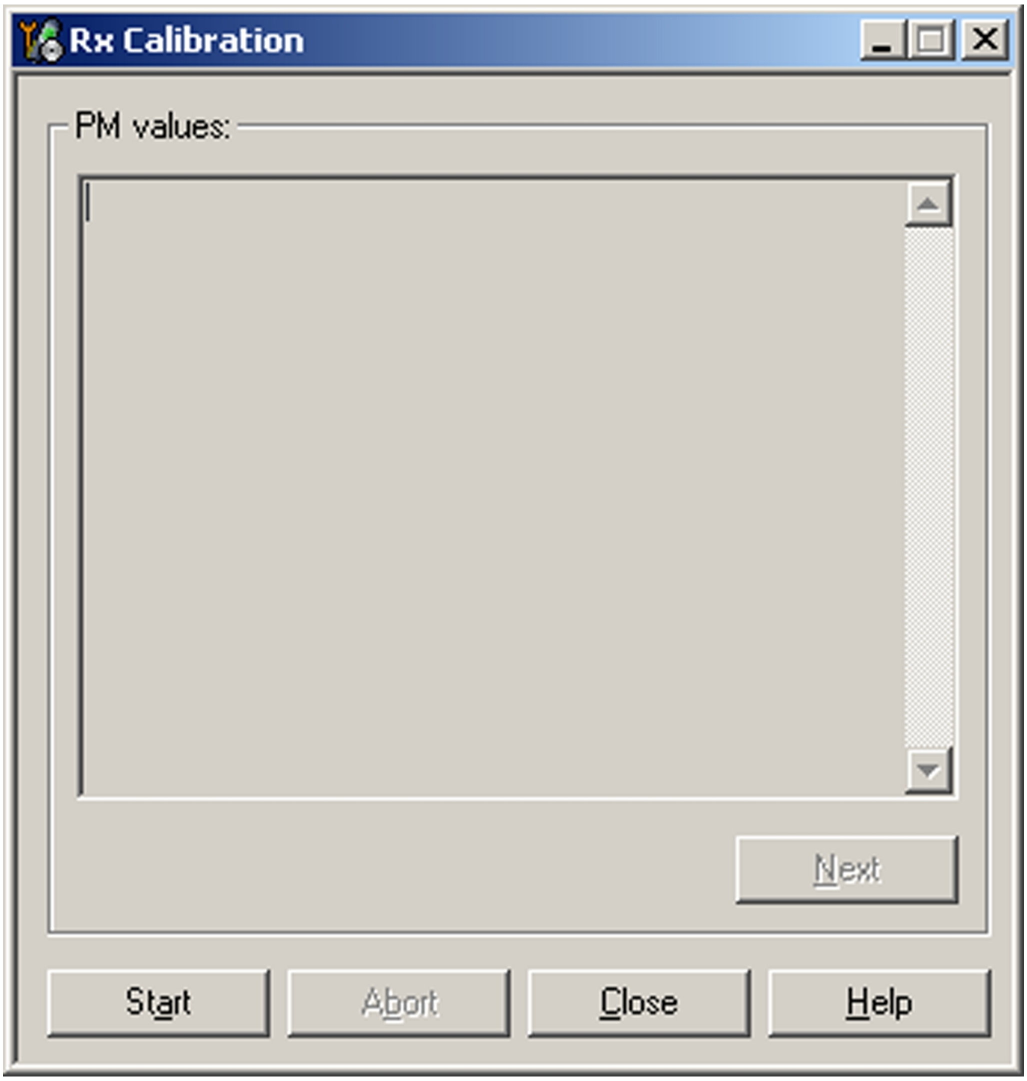
Steps

1. Connect the module jig's GSM connector to signal generator.
2. From the "Operating mode" dropdown menu, set mode to "Local".

3. From the Tuning menu, choose GSM -> Rx Calibration.


Phoenix
File Edit Product Flashing Testing Tuning Tools Window Help
Operating mode: Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
RF Channel Filter Calibration
Temperature Sensor Calibration
Rx Calibration
Rx Band Filter Response Compensation
Tx IQ Tuning
Tx Power Level Tuning
Rx Am Suppression

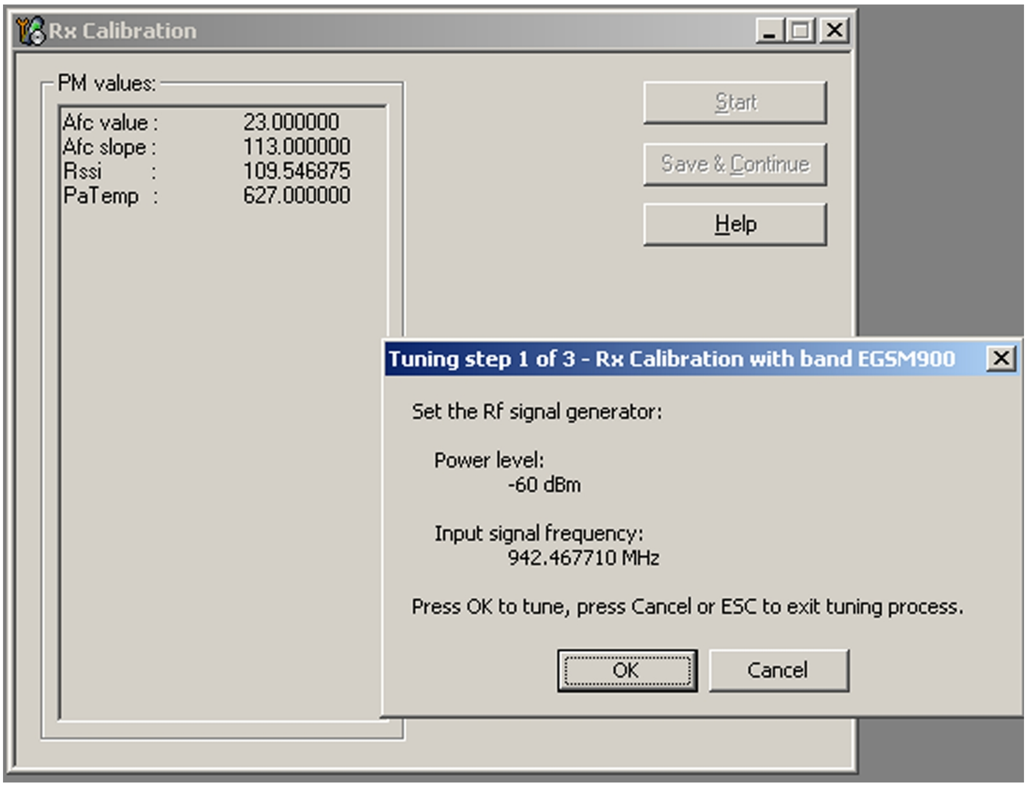
4. Check the “Load from Phone” check box and clear the “Save to Phone” check box.
5. From the Band dropdown menu, choose GSM900.
6. Click Start (if not active already).


Rx Calibration
PM values:
Next
Start
Abort
Close
Help

7. Click Calibrate.

8. Connect signal generator to the phone and set frequency and amplitude as instructed in the "Rx Calibration with band EGSM900" popup window.

   The calibration uses a non-modulated CW signal. Increase the signal generator level by cable attenuation and module jig probe attenuation!



Afc value : 23.000000
Afc slope : 113.000000
Rssi : 109.546875
PaTemp : 627.000000

Tuning step 1 of 3 - Rx Calibration with band EGSM900

Set the Rf signal generator:

Power level:
-60 dBm

Input signal frequency:
942.467710 MHz

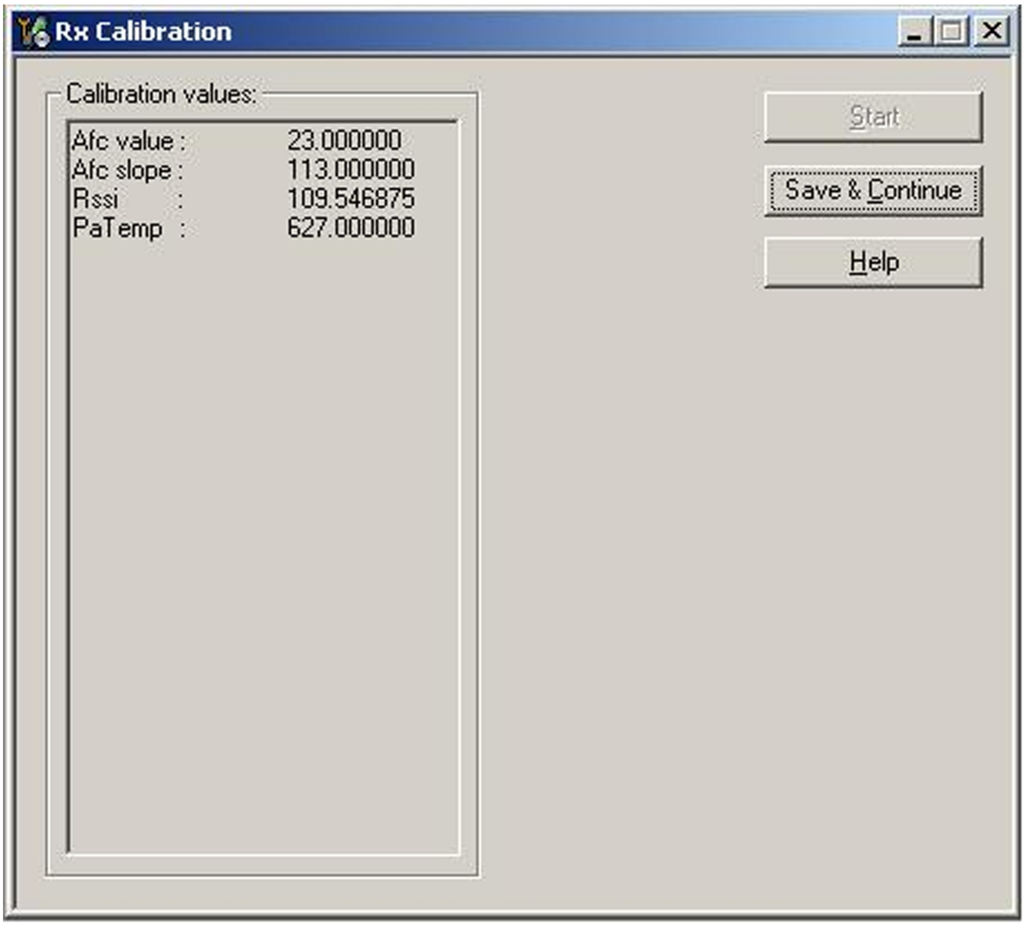
Press OK to tune, press Cancel or ESC to exit tuning process.

9. To perform tuning, click OK.
10. Check that the tuning values are within the limits specified in this table:

Table 15 RF tuning limits in Rx calibration

	Min	Typ	Max	Unit
GSM900				
AFC Value	-200	-105...62	200	
AFC slope	0	122	200	
RSSI0	106	107...110	114	dB
GSM1800				
RSSI0	104	104...109	114	dB
GSM1900				
RSSI0	104	104...109	114	dB

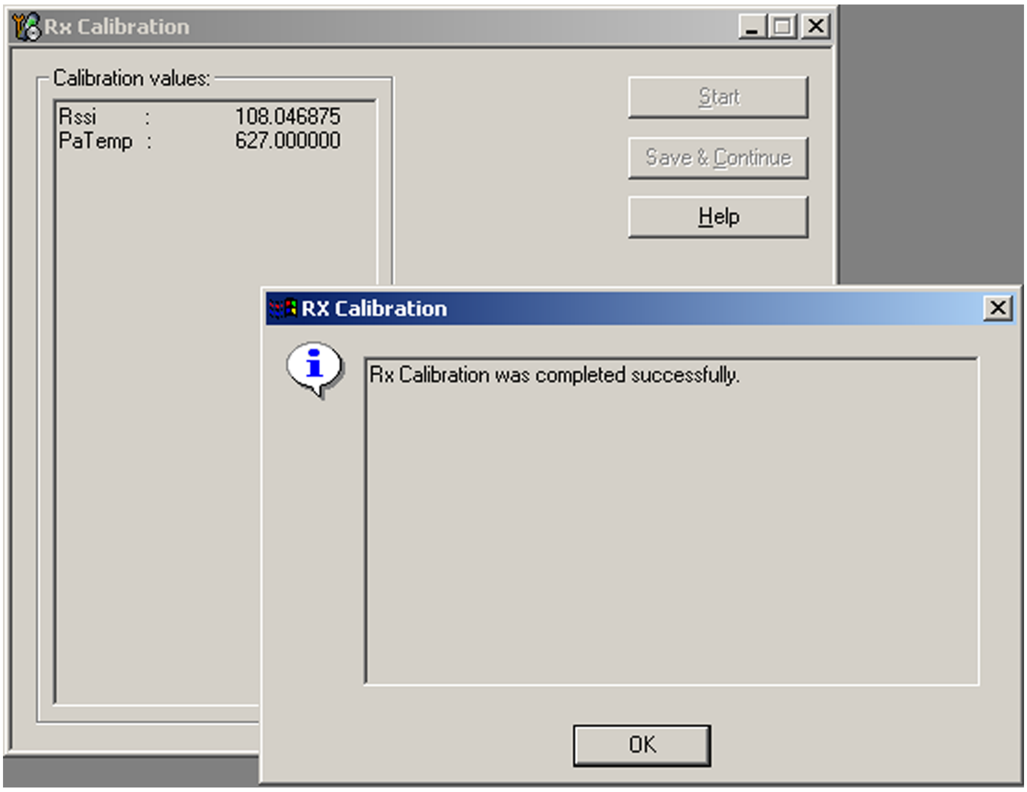
11. To save values to the phone, click "Save & Continue".


Rx Calibration
Calibration values:
Start
Save & Continue
Help

Afc value : 23.000000
Afc slope : 113.000000
Rssi : 109.546875
PaTemp : 627.000000

12. Repeat steps 3 to 8 for GSM1800 and GSM1900.

Results



Calibration values:

Rssi : 108.046875
PaTemp : 627.000000

Rx Calibration was completed successfully.

Rx band filter response compensation (GSM)

Prerequisites

Rx Calibration must be performed before the Rx Band Filter Response Compensation.

Context

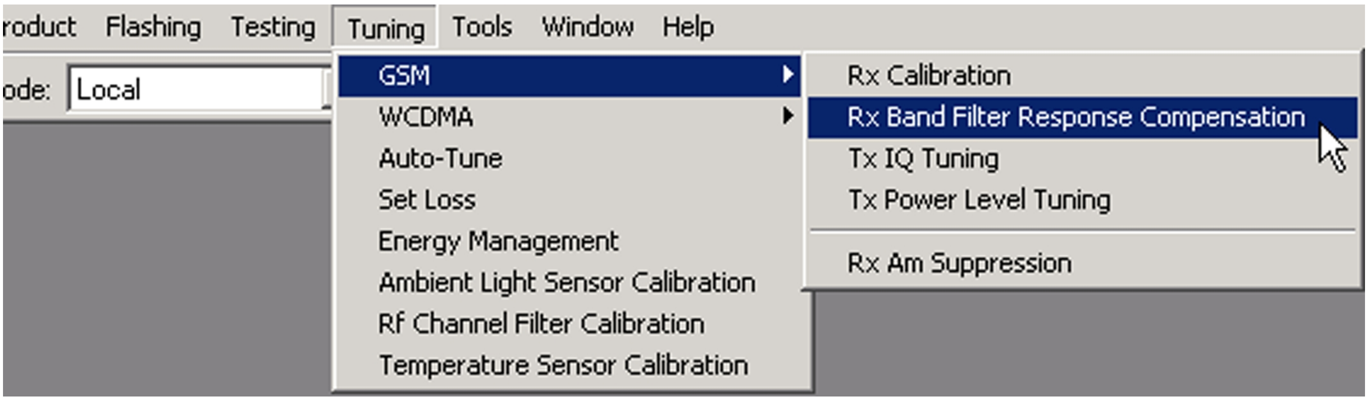
On each GSM Rx band, there is a band rejecting filter in front of the LNA (Low Noise Amplifier). The amplitude ripple caused by these filters causes ripple to the RSSI measurement and therefore calibration is needed.

The calibration has to be repeated for each GSM band.

Steps

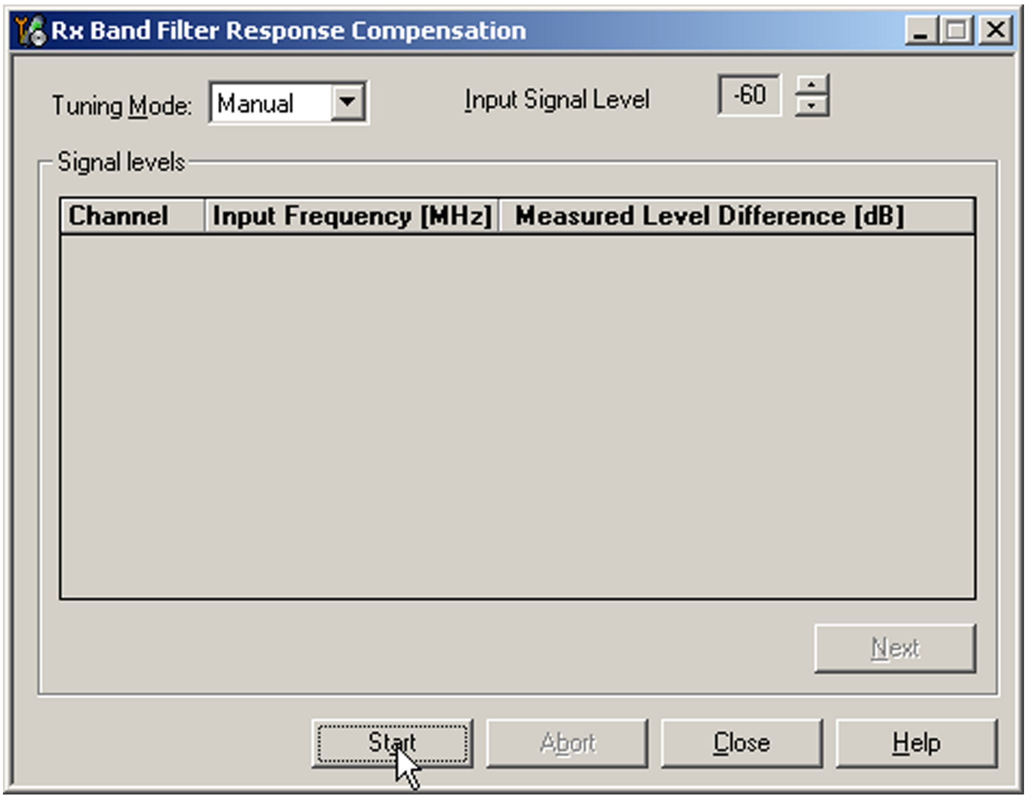
1. Connect the module jig’s GSM connector to the signal generator.
2. From the "Operating mode" dropdown menu, set mode to "Local".
3. Select GSM900 band.

4. From the Tuning menu, choose GSM -> Rx Band Filter Response Compensation.


roduct
Flashing
Testing
Tuning
Tools
Window
Help
ode:
Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration
Rx Calibration
Rx Band Filter Response Compensation
Tx IQ Tuning
Tx Power Level Tuning
Rx Am Suppression

5. In the *Tuning mode* pane, select **Manual**.

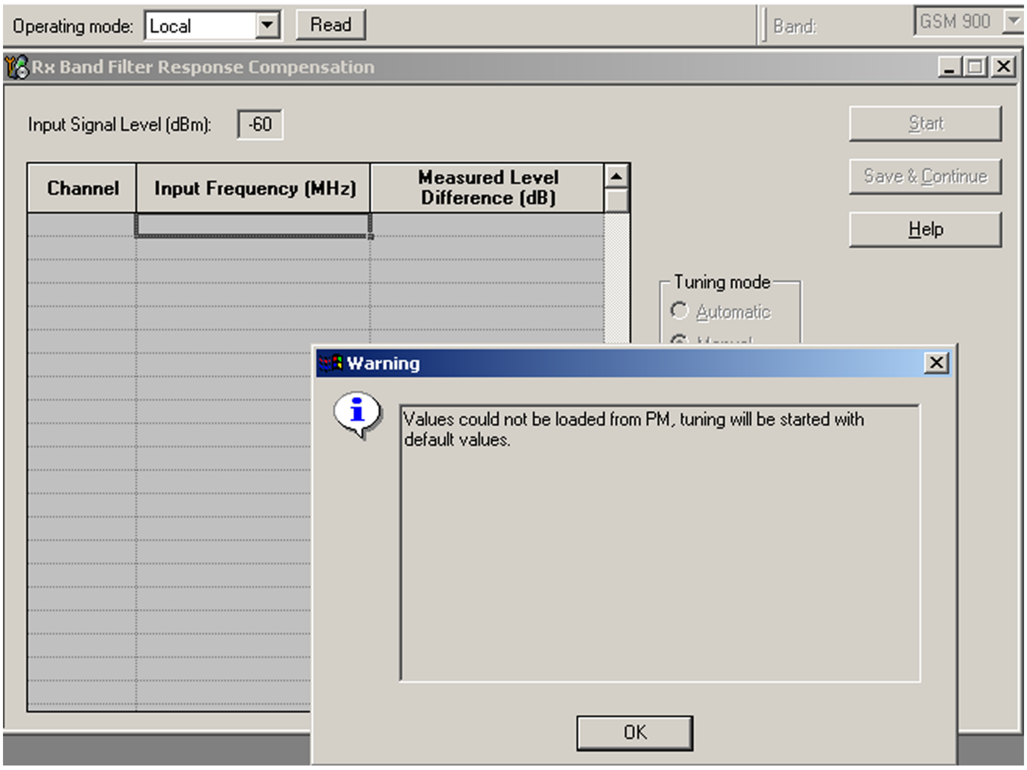
6. Click Start.


Rx Band Filter Response Compensation
Signal levels
Channel
Input Frequency [MHz]
Measured Level Difference [dB]
Next
Start
Abort
Close
Help

Tuning Mode: Manual

Input Signal Level -60

7. Click *Save & Continue*.


Read
Rx Band Filter Response Compensation
Start
Save & Continue
Help
Tuning mode
○ Automatic
Warning
OK

Operating mode: Local

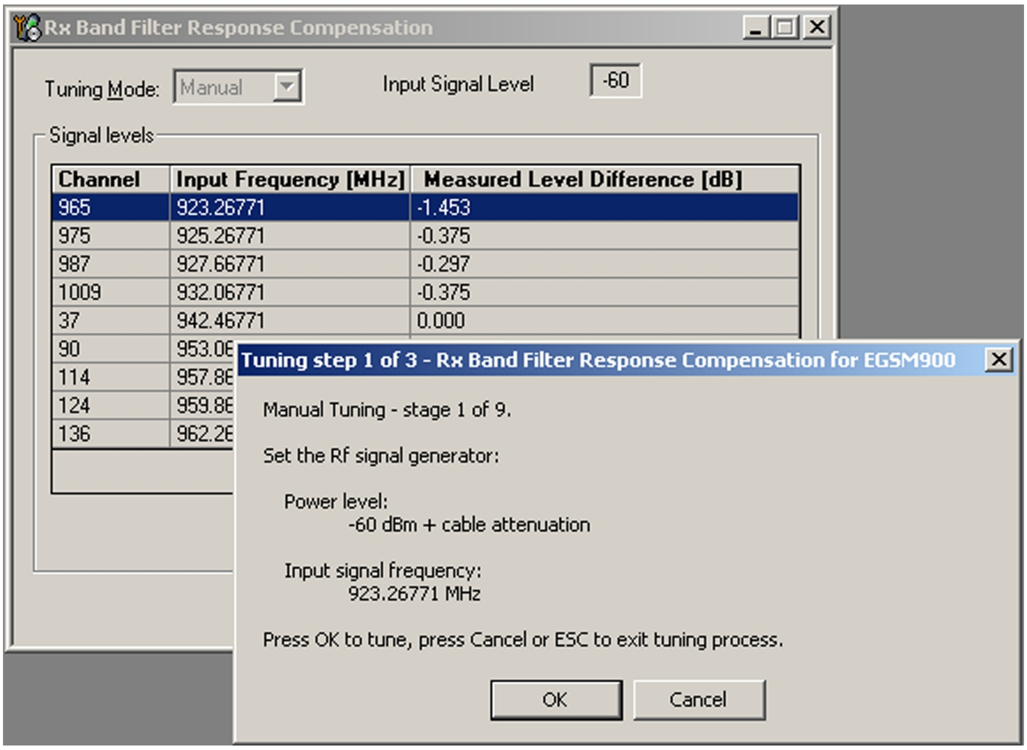
Band: GSM 900

Input Signal Level (dBm): -60

Channel	Input Frequency (MHz)	Measured Level Difference (dB)

Values could not be loaded from PM, tuning will be started with default values.

8. Connect the signal generator to the phone and set frequency and amplitude as instructed in the "Rx Band Filter Response Compensation for EGSM900" popup window.


Rx Band Filter Response Compensation
Signal levels
OK
Cancel

Tuning Mode: Manual

Input Signal Level: -60

Channel	Input Frequency [MHz]	Measured Level Difference [dB]
965	923.26771	-1.453
975	925.26771	-0.375
987	927.66771	-0.297
1009	932.06771	-0.375
37	942.46771	0.000
90	953.0	
114	957.8	
124	959.8	
136	962.2	

Tuning step 1 of 3 - Rx Band Filter Response Compensation for EGSM900

Manual Tuning - stage 1 of 9.

Set the Rf signal generator:

Power level:
-60 dBm + cable attenuation

Input signal frequency:
923.26771 MHz

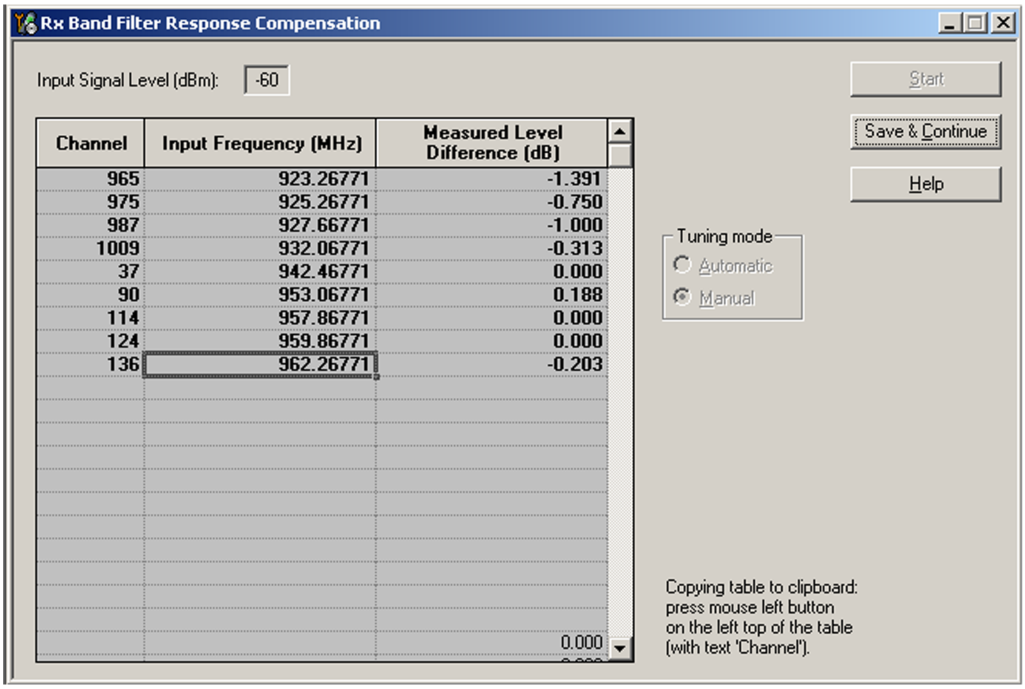
Press OK to tune, press Cancel or ESC to exit tuning process.

9. To perform tuning, click OK.
10. Go through all 9 frequencies.

11. Check that the tuning values are within the limits specified in the following table:

	Min	Typ	Max	Unit
GSM900				
Ch. 965 / 923.26771 MHz	-10	-1	5	dB
Ch. 975 / 925.26771 MHz	-3	0	5	dB
Ch. 987 / 927.66771 MHz	-3	0	5	dB
Ch. 1009 / 932.06771 MHz	-3	0	5	dB
Ch. 37 / 942.46771 MHz	-3	0	5	dB
Ch. 90 / 953.06771 MHz	-3	0	5	dB
Ch. 114 / 957.86771 MHz	-3	0	5	dB
Ch. 124 / 959.86771 MHz	-3	0	5	dB
Ch. 136 / 962.26771 MHz	-10	-1	5	
GSM1800				
Ch. 497 / 1802.26771 MHz	-10	-1	5	dB
Ch. 512 / 1805.26771 MHz	-3	0	5	dB
Ch. 535 / 1809.86771 MHz	-3	0	5	dB
Ch. 606 / 1824.06771 MHz	-3	0	5	dB
Ch. 700 / 1842.86771 MHz	-3	0	5	dB
Ch. 791 / 1861.06771 MHz	-3	0	5	dB
Ch. 870 / 1876.86771 MHz	-3	0	5	dB
Ch. 885 / 1879.86771 MHz	-3	0	5	dB
Ch. 908 / 1884.46771 MHz	-10	-1	5	dB
GSM1900				
Ch. 496 / 1927.06771 MHz	-10	-1	5	dB
Ch. 512 / 1930.26771 MHz	-3	0	5	dB
Ch. 537 / 1935.26771 MHz	-3	0	5	dB
Ch. 586 / 1945.06771 MHz	-3	0	5	dB
Ch. 661 / 1960.06771 MHz	-3	0	5	dB
Ch. 736 / 1975.06771 MHz	-3	0	5	dB
Ch. 794 / 1986.66771 MHz	-3	0	5	dB
Ch. 810 / 1989.86771 MHz	-3	0	5	dB
Ch. 835 / 1994.86771 MHz	-10	-1	5	dB

12. If the values are within the limits, click "Save & Continue".


Rx Band Filter Response Compensation
Start
Save & Continue
Help
Tuning mode
○ Automatic
● Manual

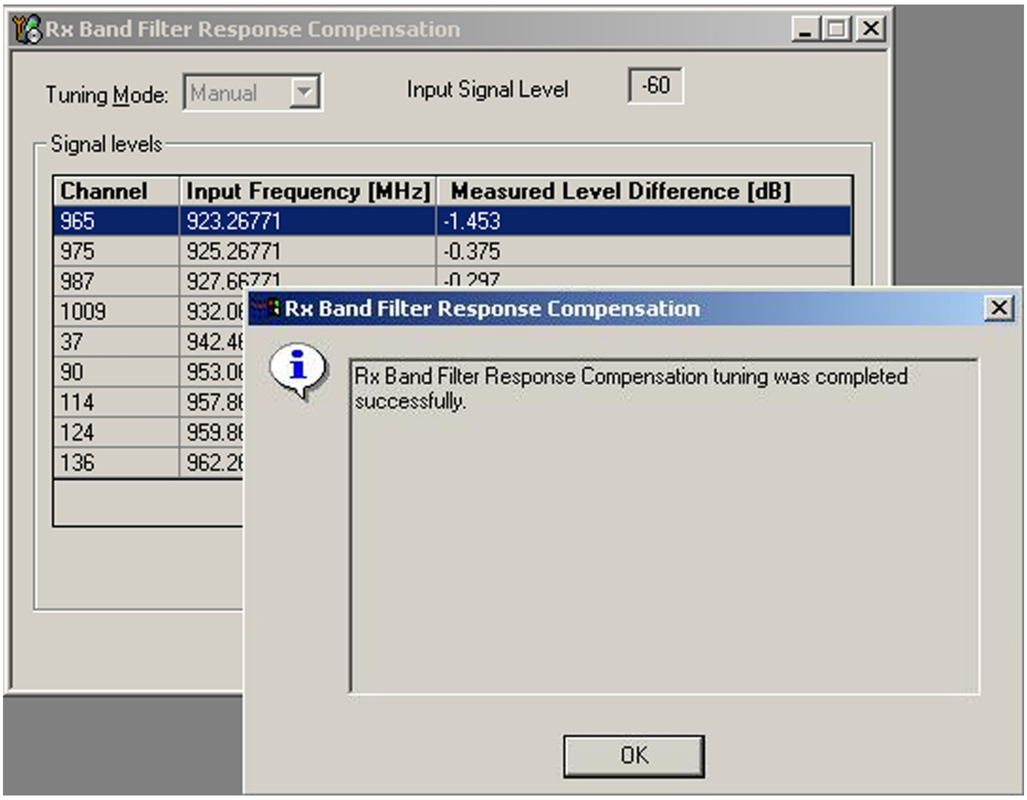
Input Signal Level (dBm): -60

Channel	Input Frequency (MHz)	Measured Level Difference (dB)
965	923.26771	-1.391
975	925.26771	-0.750
987	927.66771	-1.000
1009	932.06771	-0.313
37	942.46771	0.000
90	953.06771	0.188
114	957.86771	0.000
124	959.86771	0.000
136	962.26771	-0.203
		0.000

Copying table to clipboard: press mouse left button on the left top of the table (with text 'Channel').

13. Repeat the steps 4 to 10 for GSM1800 and GSM1900.

Results


Rx Band Filter Response Compensation
Signal levels
Rx Band Filter Response Compensation
OK

Tuning Mode: Manual

Input Signal Level -60

Channel	Input Frequency [MHz]	Measured Level Difference [dB]
965	923.26771	-1.453
975	925.26771	-0.375
987	927.66771	-0.297
1009	932.0	
37	942.4	
90	953.0	
114	957.8	
124	959.8	
136	962.2	

Rx Band Filter Response Compensation tuning was completed successfully.

GSM transmitter tunings

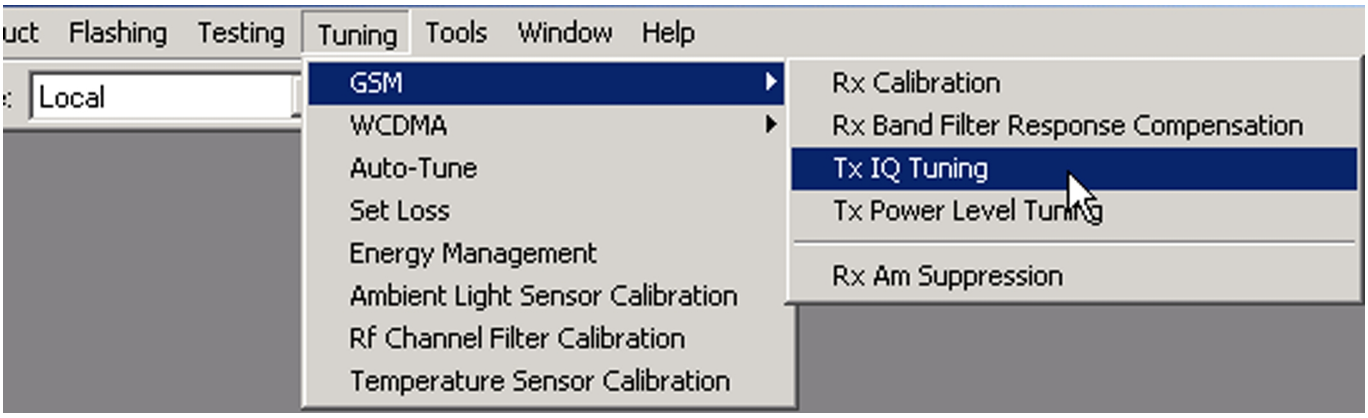
Tx IQ tuning (GSM)

Context

- The Tx path branches to I and Q signals at RF I/Q modulator. Modulator and analog hardware located after it cause unequal amplitude and phase disturbance to I and Q signal paths. Tx IQ tuning balances the I and Q branches.
- Tx IQ tuning must be performed on all GSM bands.

Steps

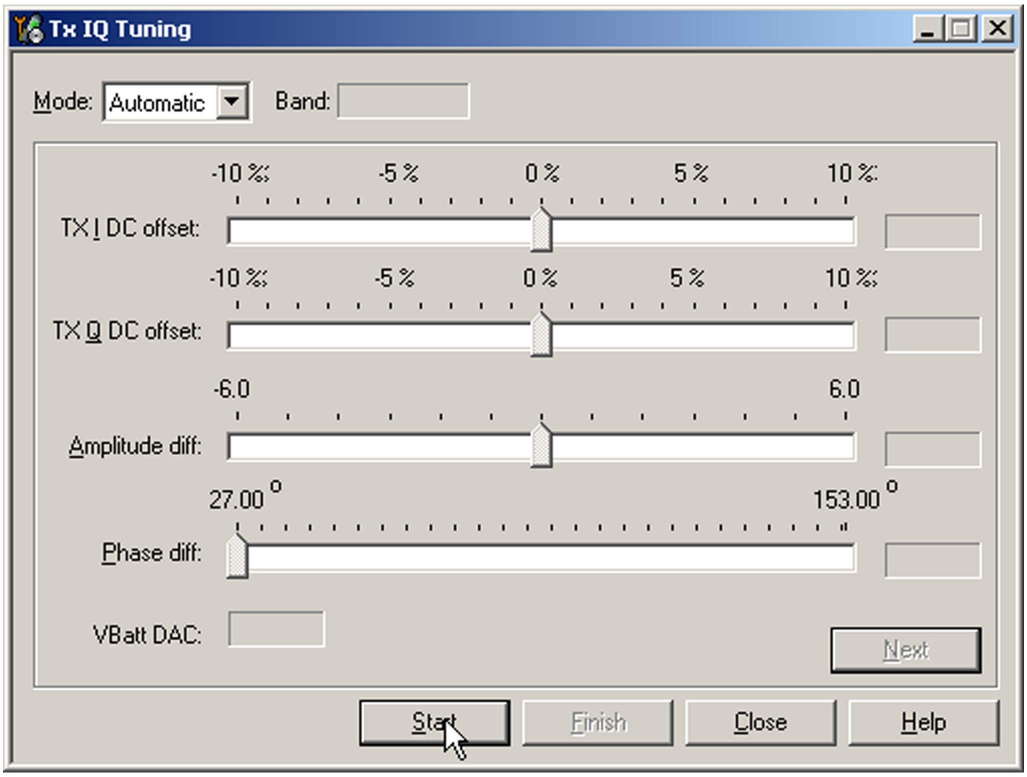
1. From the dropdown menus, set "Operating mode" to Local, "System mode" to GSM, and "Band" to GSM900.
2. From the Tuning menu, choose GSM -> Tx IQ Tuning.


uct
Flashing
Testing
Tuning
Tools
Window
Help
Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration
Rx Calibration
Rx Band Filter Response Compensation
Tx IQ Tuning
Tx Power Level Tuning
Rx Am Suppression

3. Set "Mode" to Automatic and "Edge" to Off.
4. Click Start.

   Wait until automatic tuning has finished and moved the sliders.

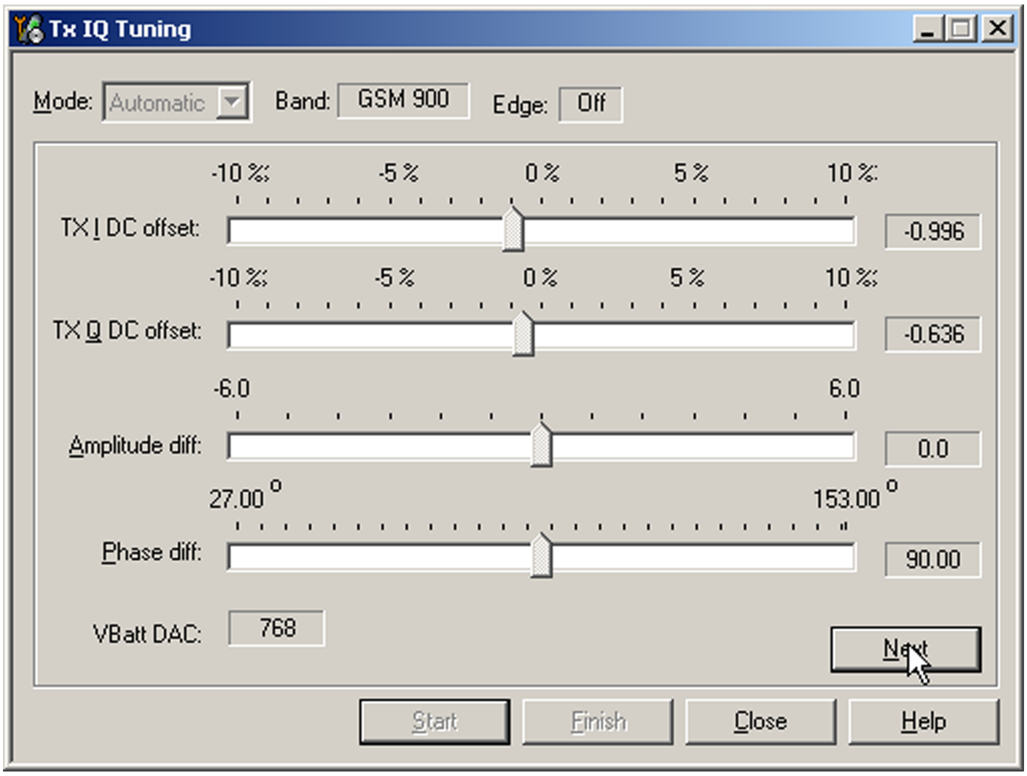
   Values are written to the phone memory automatically.



Tx IQ Tuning
-10 %
-5 %
0 %
5 %
10 %
TX I DC offset:
TX Q DC offset:
-6.0
6.0
Amplitude diff:
27.00 °
153.00 °
Phase diff:
VBatt DAC:
Next
Start
Finish
Close
Help

Mode: Automatic
Band:

5. When the values have been written to the phone memory, click Next to change to the next band.



Tx IQ Tuning
-10 %
-5 %
0 %
5 %
10 %
-6.0
6.0
27.00 °
153.00 °
Next
Start
Finish
Close
Help

Mode: Automatic
Band: GSM 900
Edge: Off
TX I DC offset: -0.996
TX Q DC offset: -0.636
Amplitude diff: 0.0
Phase diff: 90.00
VBatt DAC: 768

6. When all bands have been tuned, click Finish and Close to end the tuning procedure.

Next actions

Tuning sliders should be close to the center of the scale after the tuning and within the limits specified in the following table. If they are not within the limits, check Tx IQ quality manually.

	Min	Typ	Max	Unit
GSM900				
I DC offset / Q DC offset	-6	0	6	dB
Ampl	-1	0	1	dB
Phase	85	90	95	dB
GSM1800/GSM1900				
I/Q DC	-6	0.5	6	dB
Ampl	-1	0	1	dB
Phase	86	92	106	dB

Tx power level tuning (GSM)

Context

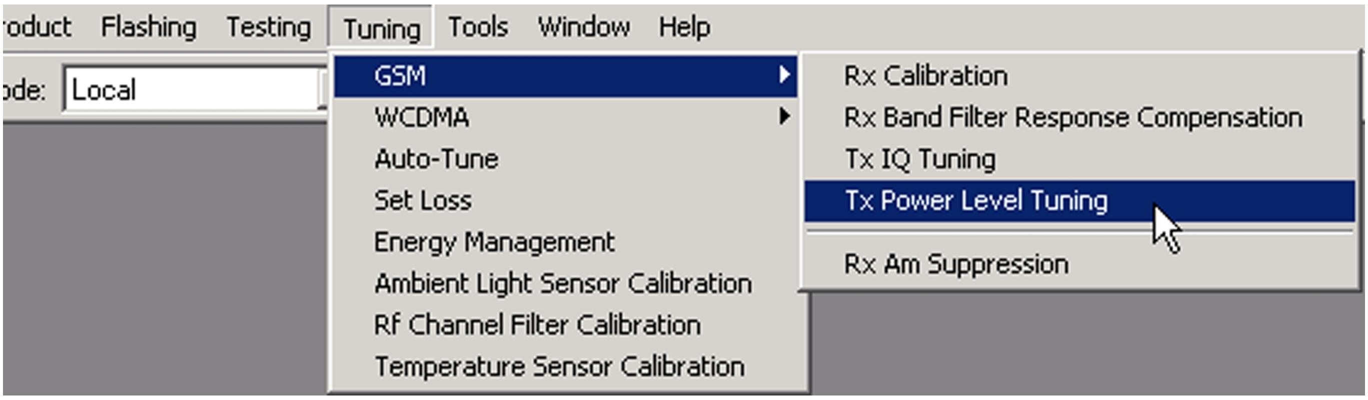
Because of variations at IC process and discrete component values, the actual transmitter RF gain of each phone is different. Tx power level tuning is used to find out mapping factors called 'power coefficients'. These adjust the GSM transmitter output power to fulfill the specifications.

For EDGE transmission the bias settings of the GSM PA are adjusted in order to improve linearity. This affects the PA gain and hence the power levels have to be aligned separately for EDGE transmission.

Tx power level tuning has to be performed on all GSM bands.

Steps

1. Connect the phone to a power meter with peak power detector or Agilent VSA Transmitter Tester.
2. Start Phoenix service software.
3. From the "Operating mode" dropdown menu, set mode to "Local".
4. From the Tuning menu, choose GSM -> Tx Power Level Tuning.

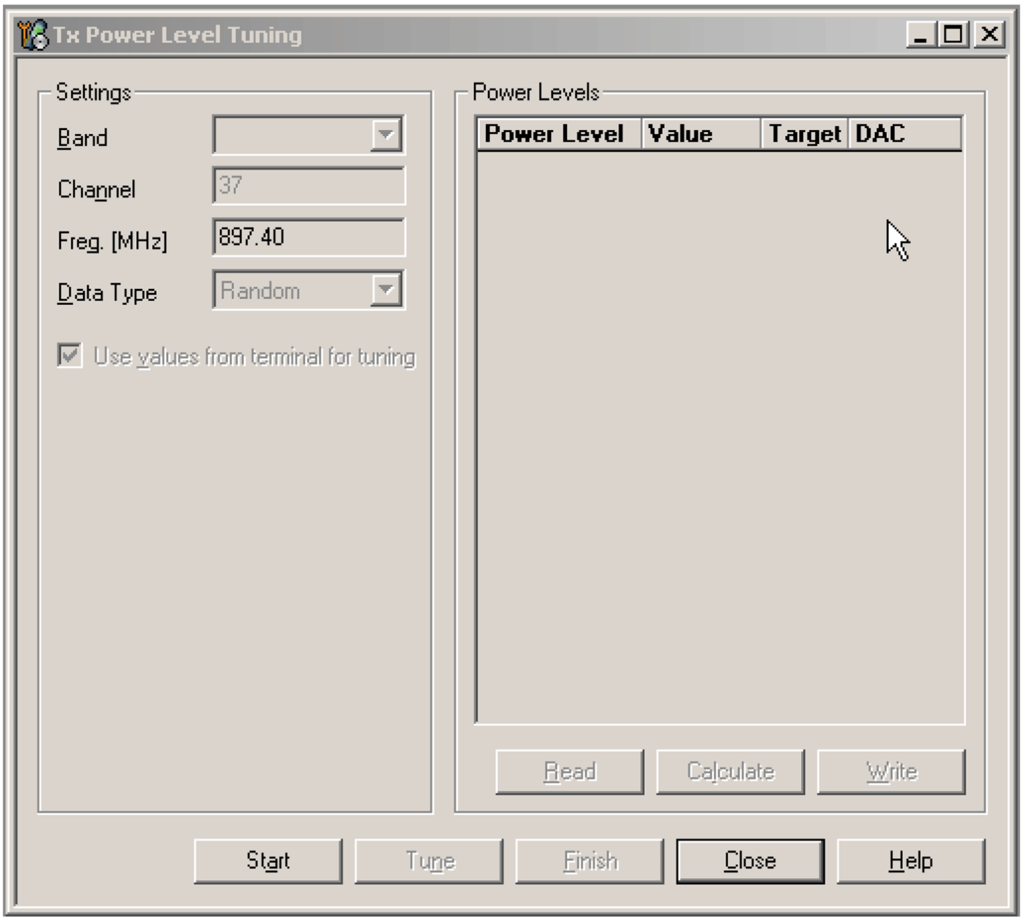

oduct
Flashing
Testing
Tuning
Tools
Window
Help
ode:
Local
GSM
WCDMA
Auto-Tune
Set Loss
Energy Management
Ambient Light Sensor Calibration
Rf Channel Filter Calibration
Temperature Sensor Calibration
Rx Calibration
Rx Band Filter Response Compensation
Tx IQ Tuning
Tx Power Level Tuning
Rx Am Suppression

5. If you are using an Agilent VSA use the settings in the table below.

Agilent VSA Transmitter Tester specific settings	
GSM900 Frequency (MHz)	897.4
GSM1800 Frequency (MHz)	1747.8
GSM1900 Frequency (MHz)	1880

Agilent VSA Transmitter Tester specific settings	
Resolution Bandwidth (MHz)	3
Video Bandwidth (MHz)	3
Trigger	Video
Sweeptime (ms)	1
Span	zero
Average (for non-EDGE)	10
Average (for EDGE)	50

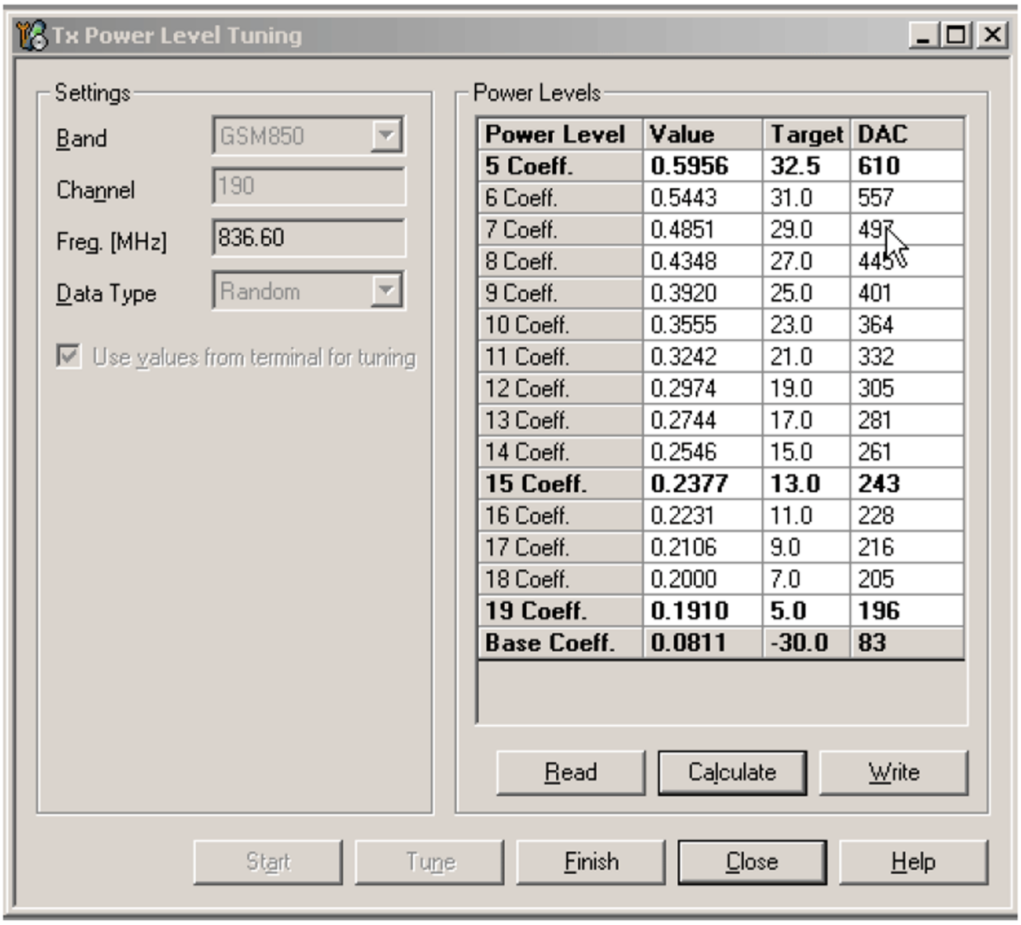
6. Click Start.


Tx Power Level Tuning
Settings
Band
Channel
Freq. [MHz]
Data Type
Power Levels
Power Level
Value
Target
DAC
Read
Calculate
Write
Start
Tune
Finish
Close
Help

Channel: 37
Freq. [MHz]: 897.40
Data Type: Random
☑ Use values from terminal for tuning

7. Select band. Set power meter or VSA to the correct frequency. Click Read and then Tune.

8. Adjust power levels **5**, **15** and **19** to correspond the "Target dBm" column by pressing + or – keys.



Band: GSM850
Channel: 190
Freq. [MHz]: 836.60
Data Type: Random
☑ Use values from terminal for tuning

Power Level	Value	Target	DAC
5 Coeff.	**0.5956**	**32.5**	**610**
6 Coeff.	0.5443	31.0	557
7 Coeff.	0.4851	29.0	497
8 Coeff.	0.4348	27.0	445
9 Coeff.	0.3920	25.0	401
10 Coeff.	0.3555	23.0	364
11 Coeff.	0.3242	21.0	332
12 Coeff.	0.2974	19.0	305
13 Coeff.	0.2744	17.0	281
14 Coeff.	0.2546	15.0	261
15 Coeff.	**0.2377**	**13.0**	**243**
16 Coeff.	0.2231	11.0	228
17 Coeff.	0.2106	9.0	216
18 Coeff.	0.2000	7.0	205
19 Coeff.	**0.1910**	**5.0**	**196**
Base Coeff.	**0.0811**	**-30.0**	**83**

Check that the coeffiecient values are within the limits specified in the following table.

	Min	Typ	Max
GSM900			
PL5 coefficient	0.45	0.677	0.75
PL15 coefficient		0.262	
PL19 coefficient	0.12	0.209	0.3
GSM900 EDGE			
PL8 coefficient	0.35	0.47	0.6
PL15 coefficient		0.261	
PL19 coefficient	0.12	0.203	0.3
GSM1800			
PL0 coefficient	0.45	0.682	0.7
PL11 coefficient		0.23	
PL15 coefficient	0.05	0.199	0.3
GSM1800 EDGE			

	Min	Typ	Max
PL2 coefficient	0.35	0.506	0.6
PL11 coefficient		0.245	
PL15 coefficient	0.05	0.2091	0.3
GSM1900			
PL0 coefficient	0.45	0.651	0.7
PL11 coefficient		0.23	
PL15 coefficient	0.05	0.201	0.3
GSM1900 EDGE			
PL2 coefficient	0.35	0.489	0.6
PL11 coefficient		0.247	
PL15 coefficient	0.05	0.212	0.3

9. If the values are within the limits, click "Calculate,Write & Finish". Repeat steps 7 to 9. for each band that needs tuning.
10. When tuning EDGE with the VSA use 50 averages and 10 averages for non-EDGE.
11. Tune EDGE power levels to the corresponding target power levels.

    Only power levels **8**, **15** and **19** are tuned in GSM900 and **2**, **10** and **15** in GSM1800/1900.
12. When the tuning is completed, close the Tx Power Level Tuning window.

WCDMA receiver tunings

RX calibration (WCDMA)

Context

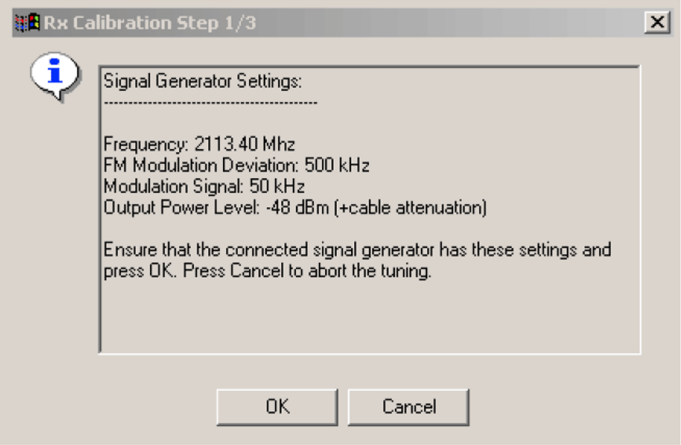
Rx calibration tuning routine calculates the real gain values of the WCDMA Rx AGC system. There is also a SAW filter between front end LNA and mixer in the receive chain, which causes ripple in the RSSI measurement, this is calibrated out. The SAW filter is intergated into RF ASIC N7500.

Rx calibration can be done in two different ways, manual tune and sweep mode tune. If the signal generator in use supports frequency sweep table, the calibration is done in one step.

Steps

1. For manual tuning, set mode to **Local** in the **Operating Mode** dropdown menu.
2. In the **Tuning** menu, choose **WCDMA→Rx Calibration** .
3. Click **Start**.
4. Select **Band**.
5. Click **Tune**.

6. Setup the signal generator to correspond with the values on the, *Rx Calibration* pop-up window and click **OK**.



Rx Calibration Step 1/3

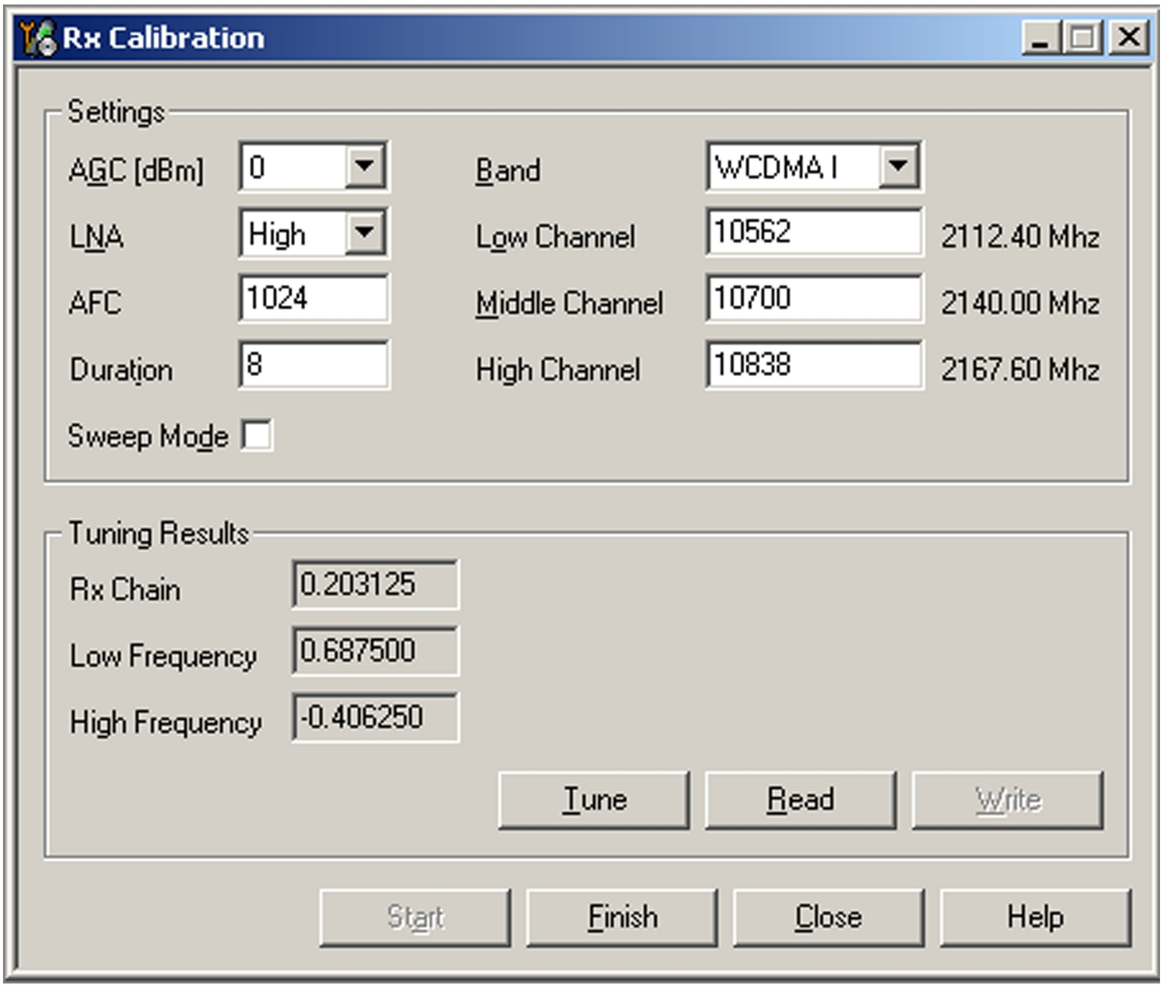
Signal Generator Settings:

Frequency: 2113.40 Mhz
FM Modulation Deviation: 500 kHz
Modulation Signal: 50 kHz
Output Power Level: -48 dBm (+cable attenuation)

Ensure that the connected signal generator has these settings and press OK. Press Cancel to abort the tuning.

Figure 18 Pop-up window for WCDMA2100

7. Repeat step 6. for Middle and High channels.



Rx Calibration

Settings

AGC [dBm]: 0
LNA: High
AFC: 1024
Duration: 8
Sweep Mode ☐
Band: WCDMA I
Low Channel: 10562 2112.40 Mhz
Middle Channel: 10700 2140.00 Mhz
High Channel: 10838 2167.60 Mhz

Tuning Results

Rx Chain: 0.203125
Low Frequency: 0.687500
High Frequency: -0.406250

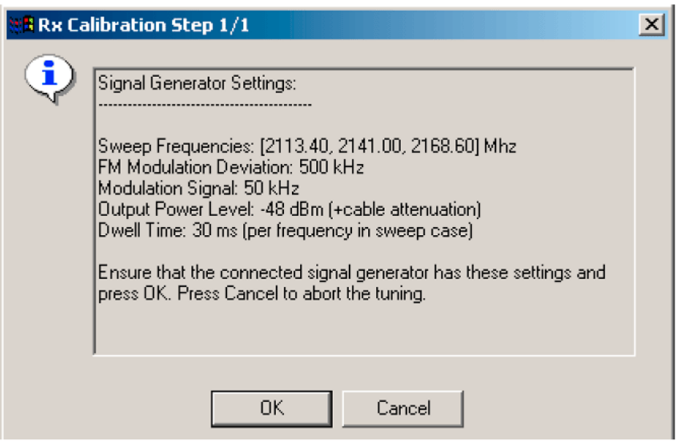
8. Ensure Tuning Results are within limits specified in the table below:

   If values are OK, click **Write** to save the values.

	Band	Min	Typ	Max	Unit
Rx chain	2100	-6	-1.5 to 1.5	6	dB
Low Frequency		-5	-1.5 to 1.5	5	
High Frequency		-5	-1.5 to 2	5	

Alternative steps

- For sweep mode tuning, set **Mode** to **Local** in the **Operating Mode** dropdown menu.
- In the **Tuning** menu, choose **WCDMA→ Rx Calibration** .
- Click **Start**.
- Select **Band**.
- Check the **Sweep Mode** box.
- Click **Tune**.
- Setup the signal generator to correspond with the values on the *Rx Calibration* pop-up window and click **OK**.



Signal Generator Settings:

Sweep Frequencies: [2113.40, 2141.00, 2168.60] Mhz
FM Modulation Deviation: 500 kHz
Modulation Signal: 50 kHz
Output Power Level: -48 dBm (+cable attenuation)
Dwell Time: 30 ms (per frequency in sweep case)

Ensure that the connected signal generator has these settings and press OK. Press Cancel to abort the tuning.

Figure 19 Pop-up window for WCDMA2100

- Ensure Tuning Results are within limits specified in the table above: If values are OK, click **Write** to save the values to the phone.
- Close the tuning window.

WCDMA transmitter tunings

Tx AGC & power detector (WCDMA)

Context

Tx AGC & power detector tuning has two purposes:

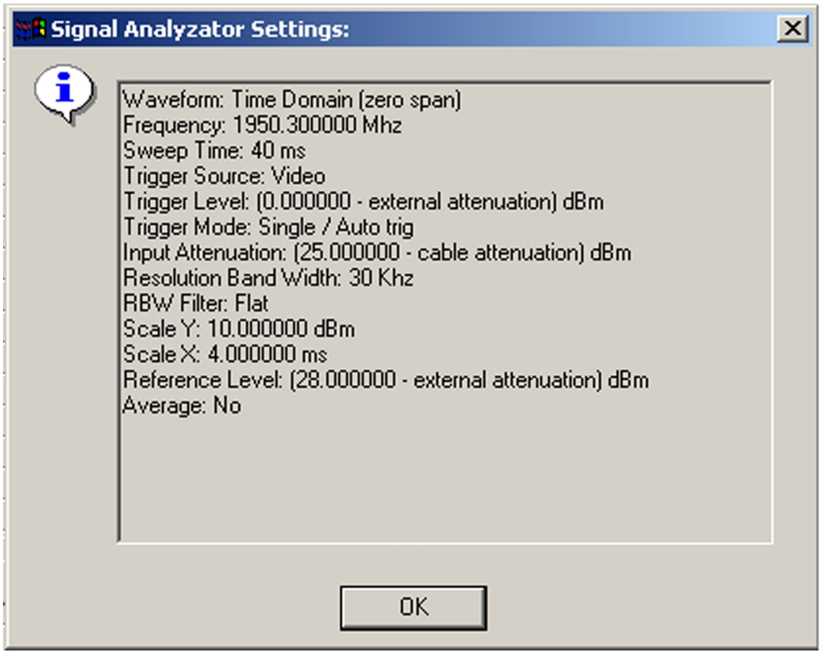
- to enable the phone to select the correct TxC value accurately in order to produce the required RF level
- to enable the phone to measure its own transmitter power accurately

There are two ways to perform the tuning. For an alternative method, see Alternative steps (page 4–52).

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.

2. Choose **Tuning→WCDMA→Tx AGC & Power Detector.**
3. Click **Start**.
4. In the *Wide Range* pane, click **Tune** (the leftmost **Tune** button).
5. Set up the spectrum analyzer in the following way:

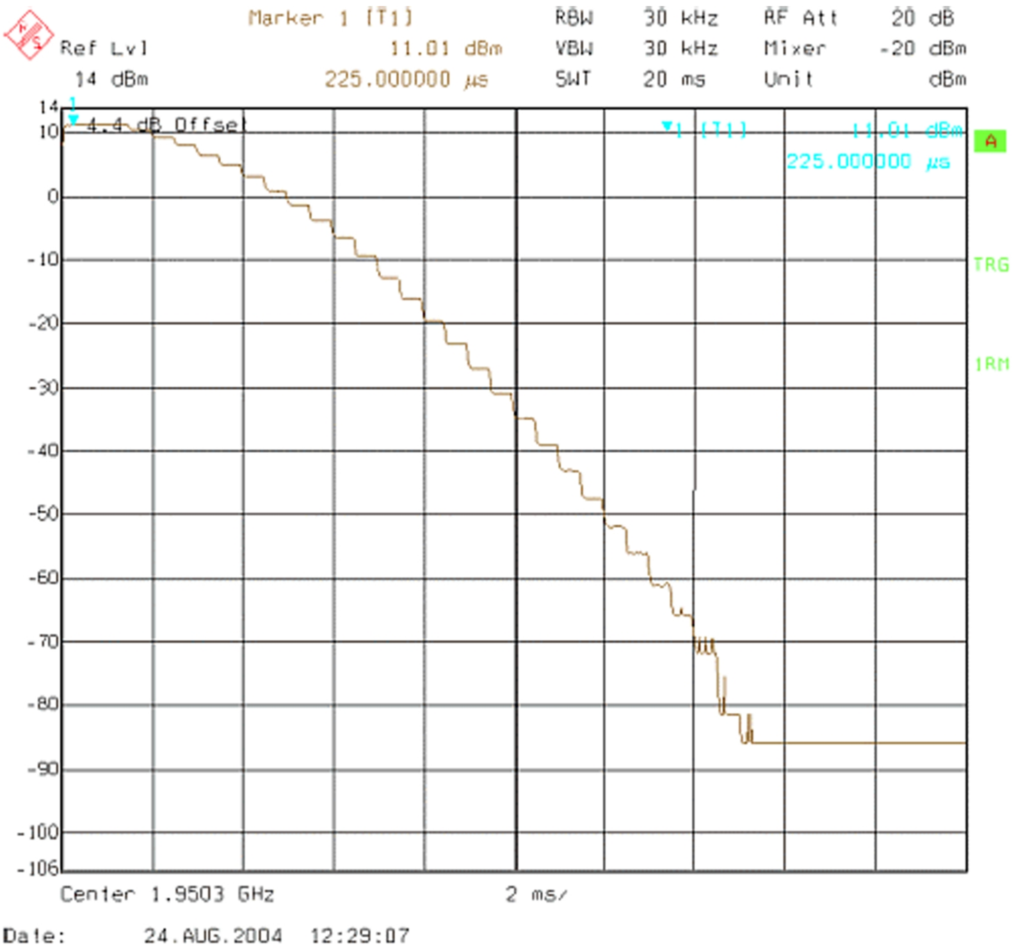


Waveform: Time Domain (zero span)
Frequency: 1950.300000 Mhz
Sweep Time: 40 ms
Trigger Source: Video
Trigger Level: (0.000000 - external attenuation) dBm
Trigger Mode: Single / Auto trig
Input Attenuation: (25.000000 - cable attenuation) dBm
Resolution Band Width: 30 Khz
RBW Filter: Flat
Scale Y: 10.000000 dBm
Scale X: 4.000000 ms
Reference Level: (28.000000 - external attenuation) dBm
Average: No

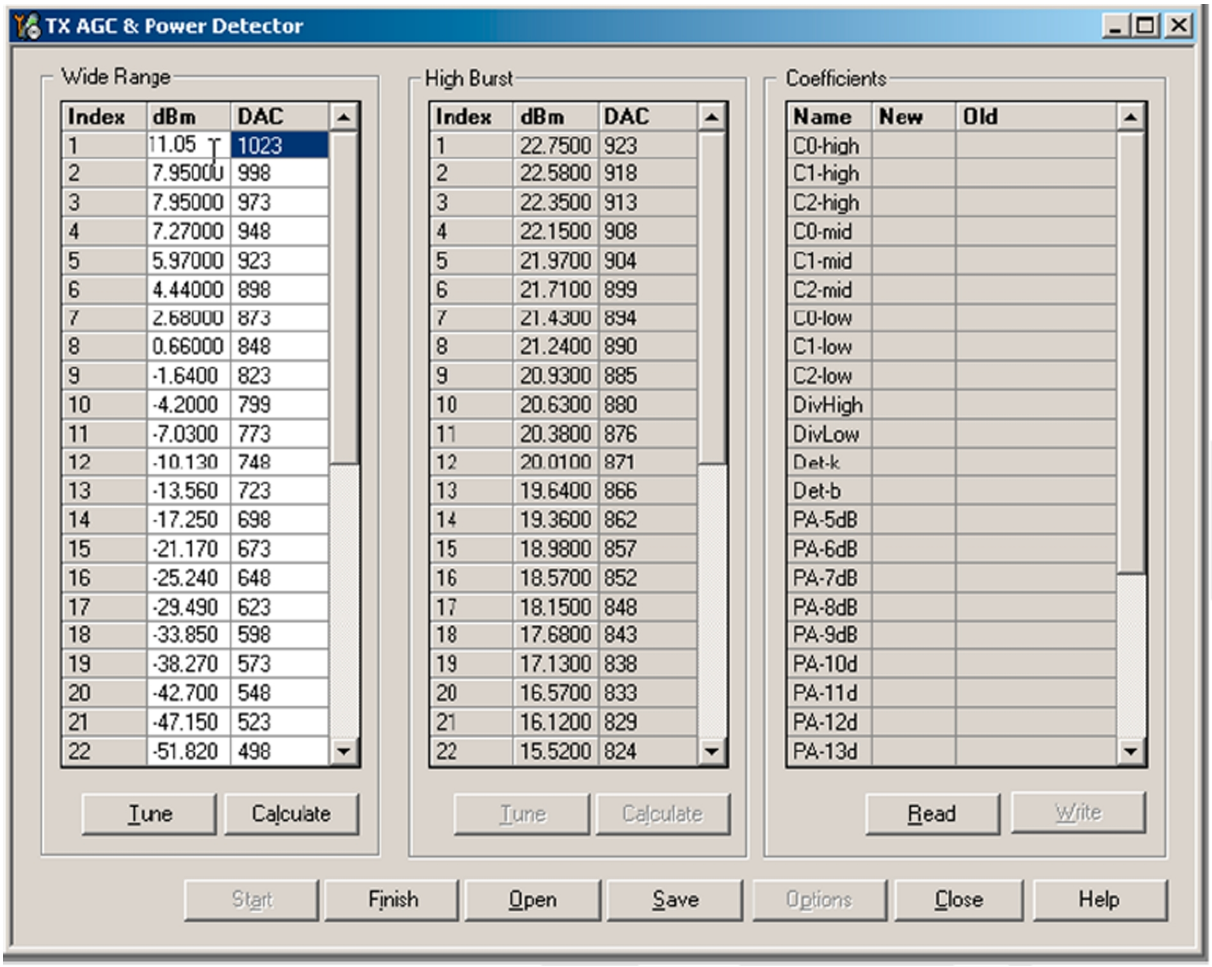
6. After setting the spectrum analyzer, click **OK**.
7. Measure the power levels with a marker.

   Take the first measurement from 250 us after the trigger, the second from 750 us, the third on 1220 us and so on in every 500 us until the table is filled.

   > **Note:** It must be possible to measure power levels down to –68 dBm. The measured power levels must be monotonously decreasing.
   >
   > Make sure that the marker is not measuring the level of noise spike on lower levels.


Marker 1 [T1]
Ref Lvl
14 dBm
11.01 dBm
225.000000 µs
RBW 30 kHz
VBW 30 kHz
SWT 20 ms
RF Att 20 dB
Mixer -20 dBm
Unit dBm
4.4 dB Offset
1 [T1] 11.01 dBm
225.000000 µs
A
TRG
1RM
14
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-106
Center 1.9503 GHz
2 ms/
Date: 24.AUG.2004 12:29:07

8. Fill in the power level values (in dBm) to the *Wide Range* table.


TX AGC & Power Detector
Wide Range
High Burst
Coefficients
Tune
Calculate
Tune
Calculate
Read
Write
Start
Finish
Open
Save
Options
Close
Help

Wide Range

Index	dBm	DAC
1	11.05	1023
2	7.95000	998
3	7.95000	973
4	7.27000	948
5	5.97000	923
6	4.44000	898
7	2.68000	873
8	0.66000	848
9	-1.6400	823
10	-4.2000	799
11	-7.0300	773
12	-10.130	748
13	-13.560	723
14	-17.250	698
15	-21.170	673
16	-25.240	648
17	-29.490	623
18	-33.850	598
19	-38.270	573
20	-42.700	548
21	-47.150	523
22	-51.820	498

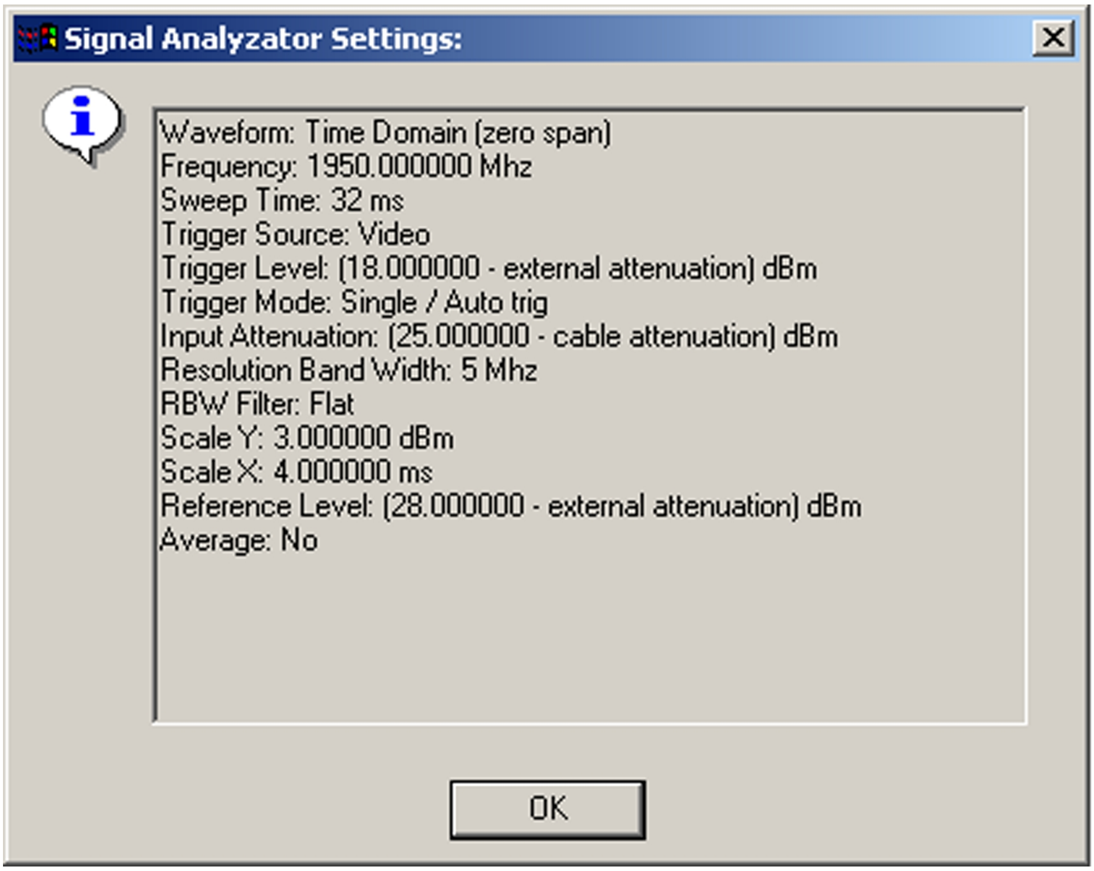
High Burst

Index	dBm	DAC
1	22.7500	923
2	22.5800	918
3	22.3500	913
4	22.1500	908
5	21.9700	904
6	21.7100	899
7	21.4300	894
8	21.2400	890
9	20.9300	885
10	20.6300	880
11	20.3800	876
12	20.0100	871
13	19.6400	866
14	19.3600	862
15	18.9800	857
16	18.5700	852
17	18.1500	848
18	17.6800	843
19	17.1300	838
20	16.5700	833
21	16.1200	829
22	15.5200	824

Coefficients

Name	New	Old
C0-high		
C1-high		
C2-high		
C0-mid		
C1-mid		
C2-mid		
C0-low		
C1-low		
C2-low		
DivHigh		
DivLow		
Det-k		
Det-b		
PA-5dB		
PA-6dB		
PA-7dB		
PA-8dB		
PA-9dB		
PA-10d		
PA-11d		
PA-12d		
PA-13d		

9. In the *Wide Range* pane, click **Calculate**.
10. In the *High Burst* pane, click **Tune**.
11. Adjust the spectrum analyzer according to the following settings:



Waveform: Time Domain (zero span)
Frequency: 1950.000000 Mhz
Sweep Time: 32 ms
Trigger Source: Video
Trigger Level: (18.000000 - external attenuation) dBm
Trigger Mode: Single / Auto trig
Input Attenuation: (25.000000 - cable attenuation) dBm
Resolution Band Width: 5 Mhz
RBW Filter: Flat
Scale Y: 3.000000 dBm
Scale X: 4.000000 ms
Reference Level: (28.000000 - external attenuation) dBm
Average: No

12. Measure the power levels with a marker.

    Take the first measurement from 250 us after the trigger, the second from 750 us, third on 1220 us and so on in every 500 us until the table is filled.

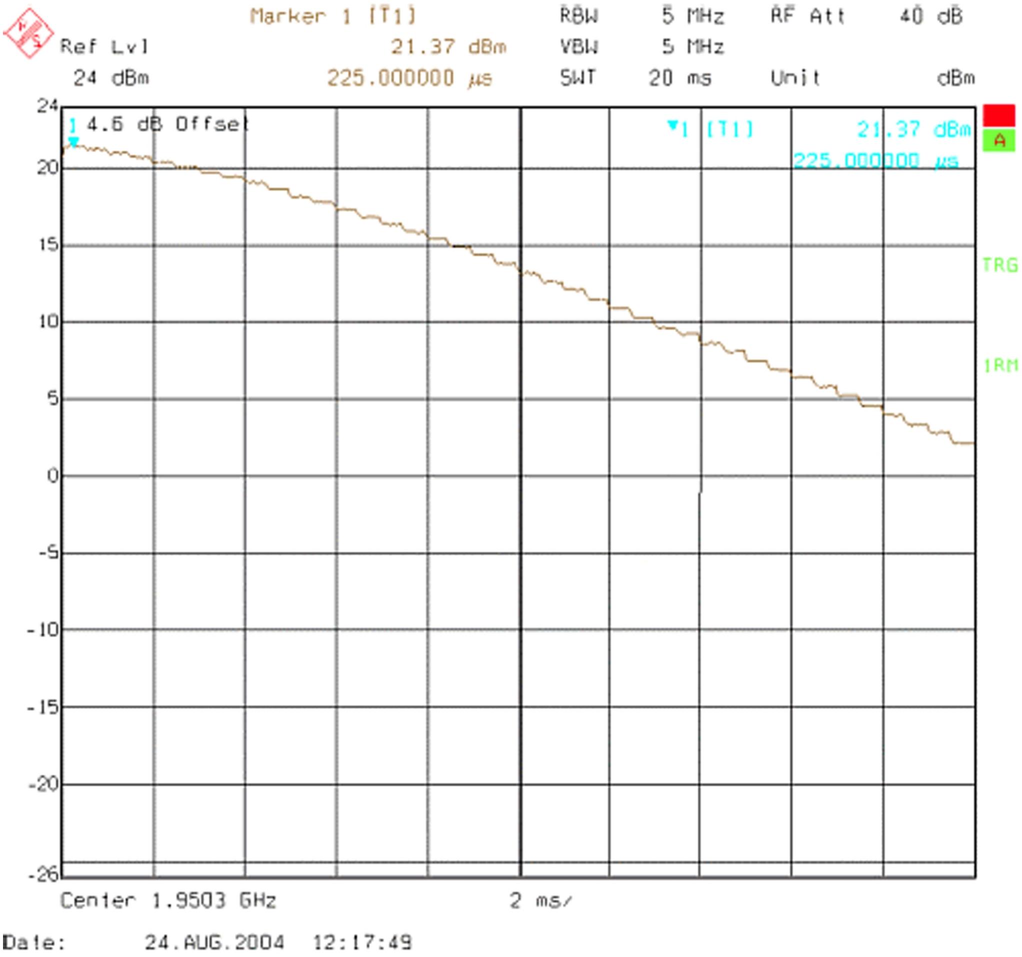


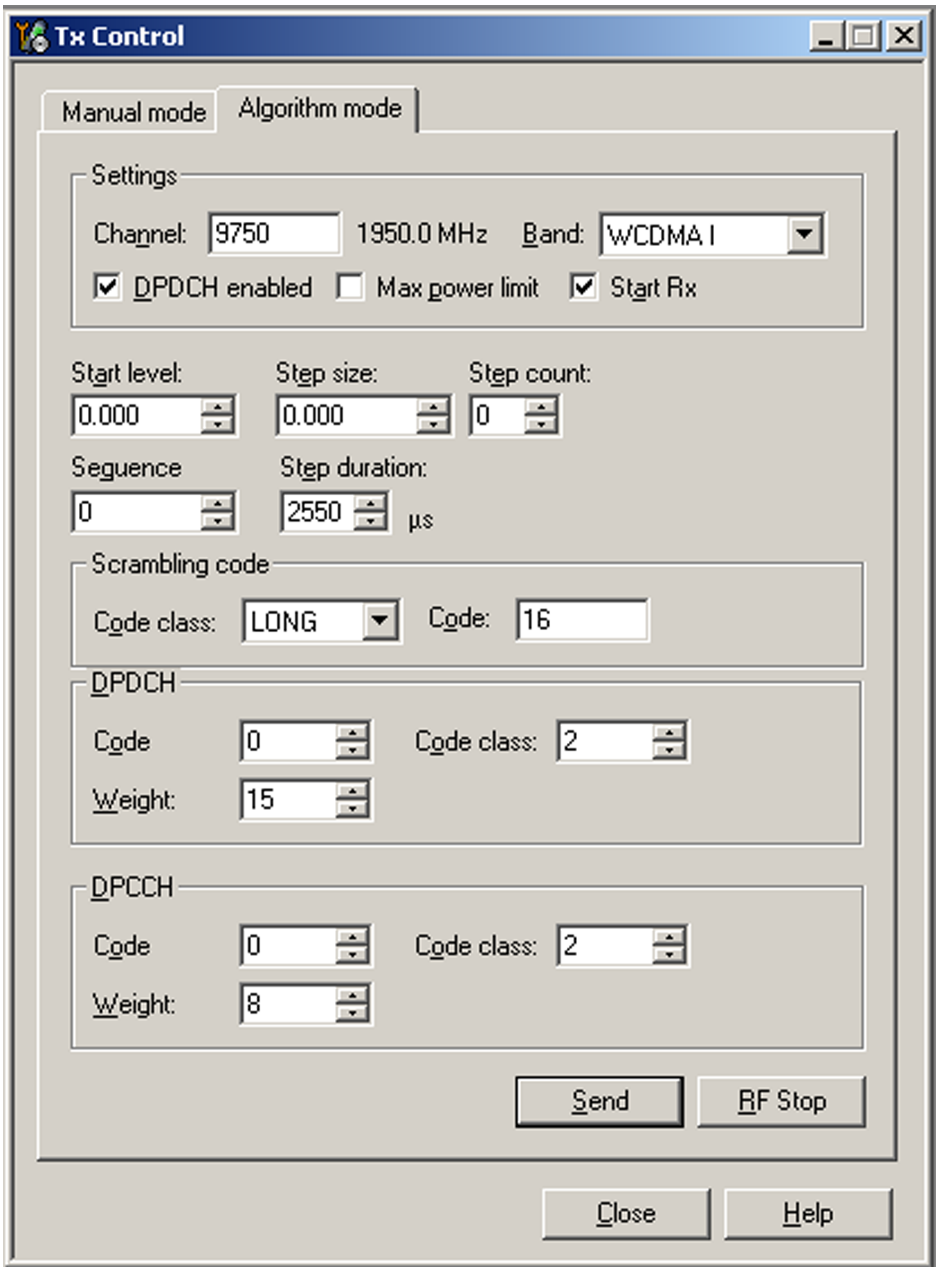
Figure 20 High burst measurement

13. In the *High Burst* pane, click **Calculate**.
14. Check that the calculated values are within the limits specified in the following table:

	Min	Max
C0-high	-0.5	5
C1-high	-50	50
C2-high	400	900
C0-mid	-0.7	0.7
C1-mid	0	50
C2-mid	400	900
C0-low	-4	4
C1-low	-400	440
C2-low	-10000	15000
Det-k	100	220
Det-b	0	150

15. To save the coefficients to the phone, click **Write**.

16. To close the *Tx AGC & Power Detector* window, click **Close**.
17. Choose **Testing→WCDMA→ Tx Control.**
18. Select the *Algorithm* mode tab.



Settings

Channel: 9750 1950.0 MHz Band: WCDMA I

☑ DPDCH enabled ☐ Max power limit ☑ Start Rx

Start level: 0.000
Step size: 0.000
Step count: 0
Sequence 0
Step duration: 2550 µs

Scrambling code

Code class: LONG Code: 16

DPDCH

Code 0 Code class: 2
Weight: 15

DPCCH

Code 0 Code class: 2
Weight: 8

19. Write the target power level 25 dBm to the *Start level* line and check the **Max power limit** check box (detector calibration check).
20. Setup the spectrum analyzer with the following settings:

Center frequency:	**1950.3 MHz**
Span:	0 Hz
Reference level offset:	Cable attenuations + adapter attenuation
Reference level:	**24 dBm or -20 dBm depending on the level measured**

Input attenuation:	Automatic
Resolution bandwidth:	5 MHz
Video bandwidth:	5 MHz
Sweep time:	20 ms
Detector:	**RMS detector**
Average:	No
Trigger:	Free run

21. Click **Send**.
22. Measure the WCDMA output power.

    It should be around 21 dBm.
23. Click **RF Stop** and uncheck the **Max power limit** check box.
24. Repeat steps **19** to **23** for levels +19, +7, 0, -20 and –40 dBm.

    The measured output power may not differ more than +-2 dB from the requested value at level +19 dBm and no more than +-4 dB on lower levels.

    Remember to stop the RF before sending new data.

Alternative steps

- Measure the wide range levels normally and write down the levels that are possible to measure.
- Click **Finish**.
- Click **Options**.
- Change the first wide range DAC value to *573* and change the number of tuning steps to *21*.
- Change the spectrum analyzer reference level to *–20* dBm and adjust the input attenuator to the lowest value possible.
- In the *Wide Range* pane, click **Tune** and fill in the rest of values starting from the 19th level.

Tx band response calibration (WCDMA)

Context

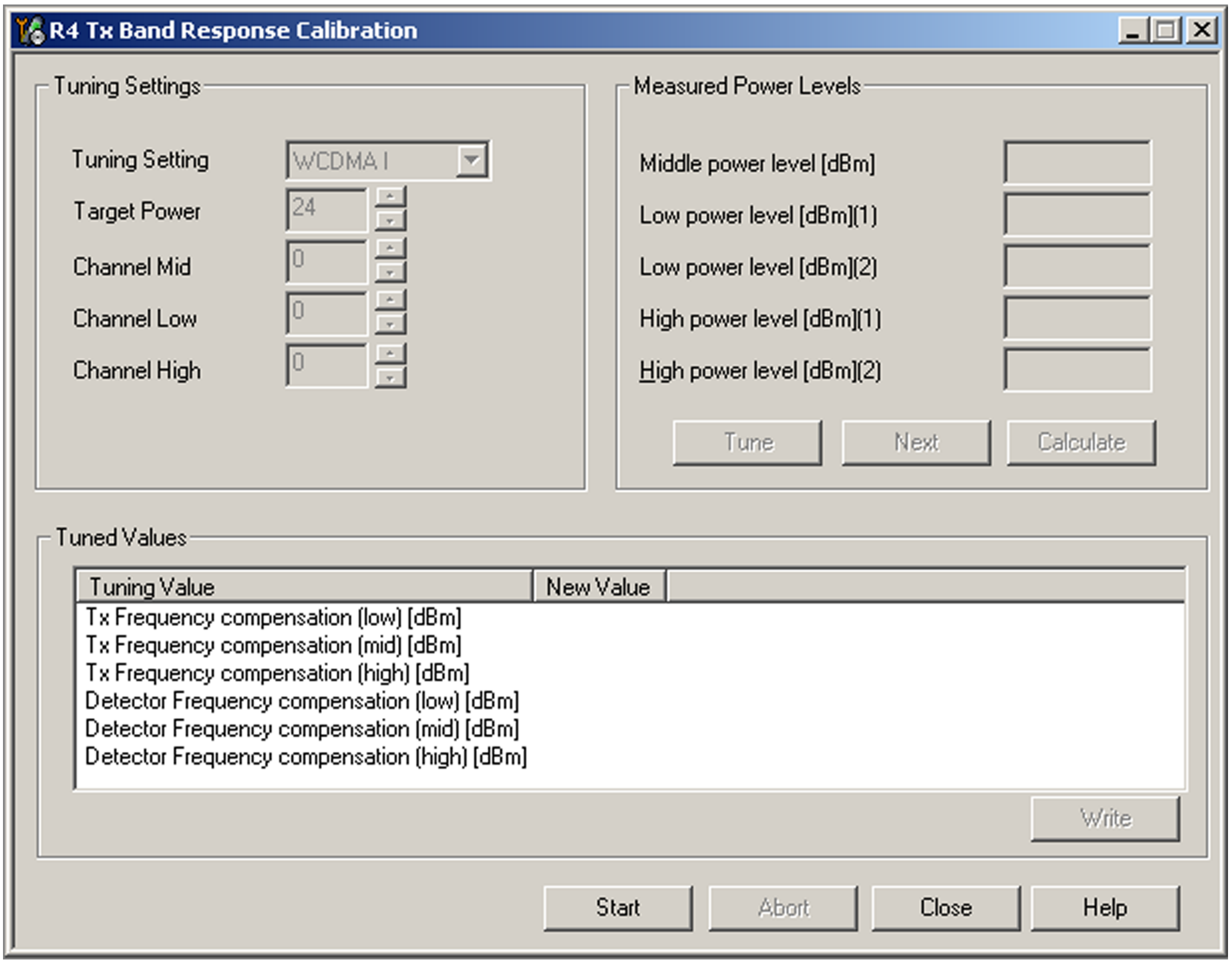
The purpose of this tuning operation is to calibrate the WCDMA Tx performance. It defines the power detector and Tx frequency compensation values. However, before starting this tuning procedure, it is necessary to carry out Tx AGC & Power Detector Calibration tuning. This is because its results will be needed for this tuning operation.

- In the *Tuning Settings* pane, it is possible to edit the numbers of channels used in this tuning operation.
- If the **Calibrate Detector Response** check box is checked, only Tx response is calibrated. Zero is written to the power detector compensation values block in the permanent memory (PM) of the terminal.
- **Detector Calibration level** shows the power level used for calibrating the power detector in this tuning procedure.
- **Tx Calibration level** shows the power level used for calibrating tx frequency in this tuning procedure.
- In the *Measured Power Levels* pane, you can insert the dBm values read from the power meter.
- In the *Tuned Values* pane, the values that are stored in the permanent memory (PM) of the terminal in Current columns are shown.
- New values are added to *New* column when the **Calculate** button is clicked.

- The **Abort** button aborts the tuning operation without saving the tuned values.
- The n**Read** button reads the tuned values in the PM of the terminal, and displays them in the *Tuned Values* pane in in the *Current* column.

Steps

1. Start *Phoenix* service software.
2. Choose **File→Scan Product** .
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning→WCDMA→Tx Band Response Calibration** .
5. Click **Start**.


R4 Tx Band Response Calibration
Tuning Settings
Measured Power Levels
Middle power level [dBm]
Low power level [dBm](1)
Low power level [dBm](2)
High power level [dBm](1)
High power level [dBm](2)
Tune
Next
Calculate
Tuned Values
Write
Start
Abort
Close
Help

Tuning Setting WCDMA I
Target Power 24
Channel Mid 0
Channel Low 0
Channel High 0

Tuning Value	New Value
Tx Frequency compensation (low) [dBm]	
Tx Frequency compensation (mid) [dBm]	
Tx Frequency compensation (high) [dBm]	
Detector Frequency compensation (low) [dBm]	
Detector Frequency compensation (mid) [dBm]	
Detector Frequency compensation (high) [dBm]	

The current values are shown in the *Tuned Values* pane.

6. Click **Tune**.
7. **Note:** In the steps 8-15 always ensure that measurement trigger is on before clicking OK/Next to ensure that the spectrum analyzer measures the power.
8. Set up Spectrum analyzer with the values described in a pop up window and **press OK**
9. Read the power level (dBm) during the burst and enter it to Middle Power Level[dBm]. **Click Next**.
10. Set spectrum analyzer frequency to low channel. **Click Next**.
11. Read the power level (dBm) during the burst and enter it to Low Power Level[dBm][1}. **Click Next**.
12. Read the power level (dBm) during the burst and enter it to Low Power Level[dBm][2}. **Click Next**.

13. Set spectrum analyzer frequency to high channel. **Click Next**.
14. Read the power level (dBm) during the burst and enter it to High Power Level[dBm][1}. Click Next.
15. Read the power level (dBm) during the burst and enter it to High Power Level[dBm][2}. **Click Next**.
16. Click **Calculate**.

    The tuned values are shown in the *Tuned Values* pane in the *New* column.
17. Check that the tuned values are within the limits presented in the following table. If they are OK, click **Yes**.

	Min	Max
Tx Freq Comp (the first and last value)	-4	+4

18. To save the tuned values to the terminal, click **Write**.
19. Close the *Tx Band Response Calibration* window.

Tx LO leakage (WCDMA)

Context

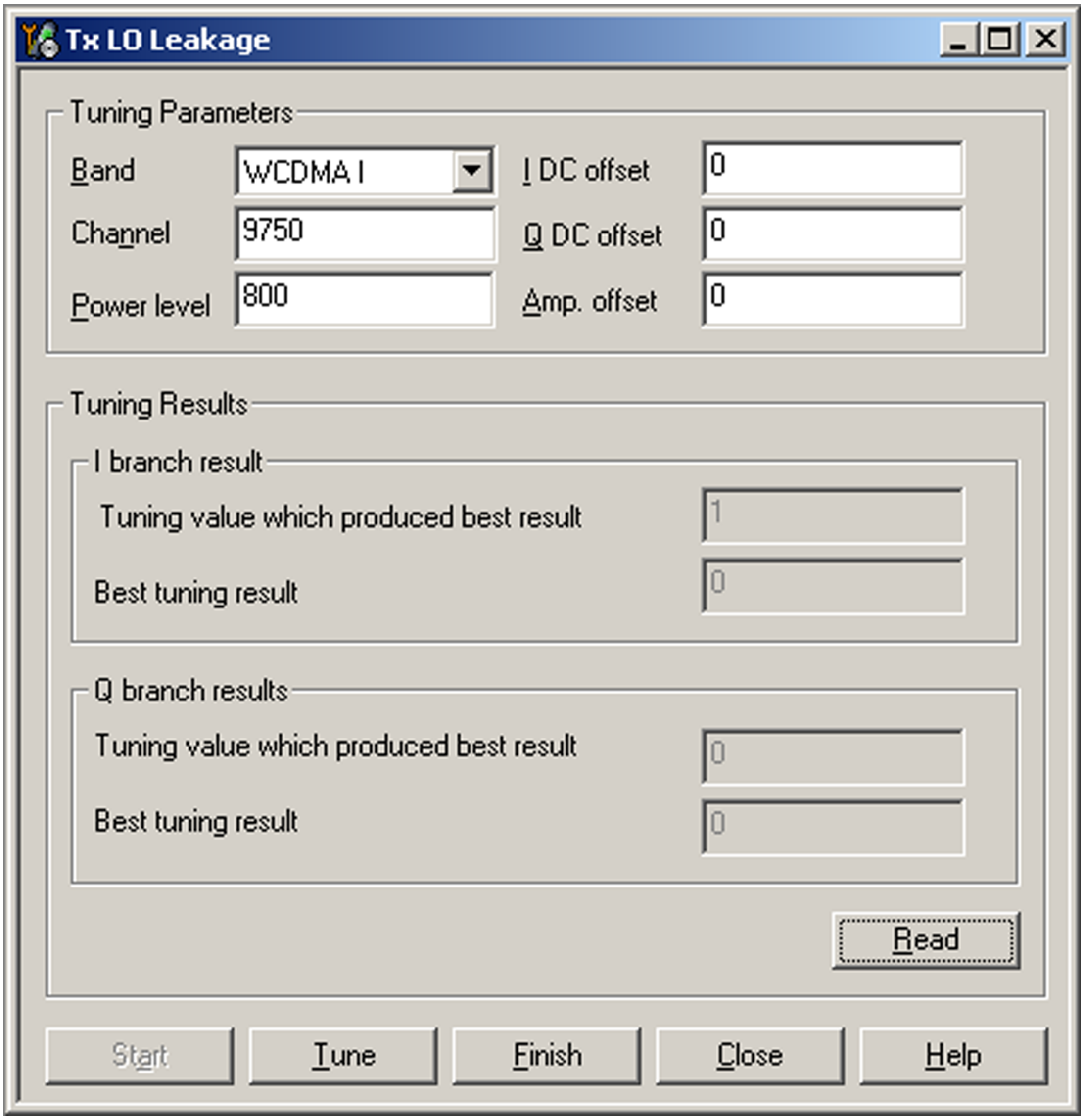
The purpose of Tx LO leakage tuning is to minimize the carrier leakage of the IQ-modulator which is caused by the DC offset voltages in the Tx IQ-signal lines and in the actual IQ modulator.

The tuning improves WCDMA Tx AGC dynamics at low power levels. A self-calibration routine selects the best combination for internal control words in order to produce minimum LO leakage.

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning**→**WCDMA**→ **Tx LO Leakage** .

3. Click **Tune**.


Tx LO Leakage
Tuning Parameters
Tuning Results
I branch result
Q branch results
Read
Start
Tune
Finish
Close
Help

Band: WCDMA I
Channel: 9750
Power level: 800
I DC offset: 0
Q DC offset: 0
Amp. offset: 0

I branch result
Tuning value which produced best result: 1
Best tuning result: 0

Q branch results
Tuning value which produced best result: 0
Best tuning result: 0

4. To end the tuning, click **Close**.

Antenna troubleshooting

Context

The antennas have contacts with the engine PWB via five springs.

The mechanical construction and antenna are described below.

The RM-194 antenna figure TBD.

Symptoms anticipated:

- radiated power degradation, e.g. signal bar is low compared to other phones

Required equipment:

- call test
- ASM coupler
- RF cables

You can use the following table for the coupling loss for the main GSM coupler; you may also need to include RF cable loss.

Attenuation values for inductive RF coupler SA-112						
Band	**Channel**	**Attenuation RX**	**Tolerance RX**	**Attenuation TX**	**Tolerance TX**	**Reported power**
GSM 900	Low 975	8.7	+/-4.5dB	10.9	+/-4.5dB	30'+/-4.5dBm
	Mid 62	10.1		9.4		
	High 124	11.9		8.4		
GSM 1800	Low 513	9.6	+/-4.5dB	7.5	+/-4.5dB	30'+/-4.5dBm
	Mid 700	9.5		7.6		
	High 884	8.4		9		
GSM 1900	Low 513	14.7	+/-4.5dB	9.5	+/-4.5dB	30'+/-4.5dBm
	Mid 661	20.2		8.4		
	High 809	21.3		11		
WCDMA	Low	17.7	+/-4.5dB	21.6	+/-4.5dB	24'+/-4.5dBm
Band I						

Steps

1. Place the phone into the AMS coupler jig, establish a call and set the path loss using the above attenuation TX.
2. Check the report power level for the UE. If it is not in the target range 31.7+/-4.5dB it may indicate that one of the antenna connection pins may not contact to the PWB.
3. Replace the antenna.
4. Repeat steps 2 and 3. If the power level is within the target range, the replaced antenna was broken; otherwise, other RF part might not function properly. In this case RF troubleshooting should be carried out.

5 — Camera Module Troubleshooting

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Introduction to camera module troubleshooting

Introduction to camera module troubleshooting

Background, tools and terminology

Faults or complaints in camera operation can be roughly categorised into three subgroups:

1. Camera is not functional at all; no image can be taken.
2. Images can be taken but there is nothing recognizable in them.
3. Images can be taken, and they are recognizable but for some reason the quality of images is seriously degraded.

It is hard to measure image quality quantitatively. Even comparative measurements are difficult (comparing two images) to perform, if the difference is small. Especially, if the user is not satisfied with his/her device's image quality, it is fairly difficult to accurately test the device, and get an exact figure that would tell whether the device is functioning properly.

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable. Some training or experience of a correctly operating reference device may be needed in order to detect what actually is wrong.

It is easy for the user to take bad images in bad conditions. Therefore, the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference. Experience helps significantly in analysing image quality.

Terms

Autofocus (AF)	The camera module contains lens movement mechanics for focus adjustment. Autofocus enables camera to take sharp images of objects positioned between 30 cm to infinity. In the AF mode, the viewfinder image is momentarily blurred as the camera searches for the right focus setting.
Digital Zoom	A digital zoom can be described as a form of cropping the image. When using a digital zoom, the camera enlarges the image area at the centre of the frame and discards the outside edges of the image.
Dynamic range	The ability of the camera to capture details in dark and bright areas of the scene simultaneously.
Exposure time	Camera modules use a silicon sensor to collect light and to form an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter images. The operation principle is exactly the same with a silicon sensor.
Flicker	Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image.
Noise	Variation of response between pixels with same level of input illumination.
Resolution	The amount of pixels in the camera sensor. In some occasions the term resolution is used for describing the sharpness of the images.

Sensitivity	The light sensitivity of the camera. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film.
Sharpness	Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance. Image gets softer at increased zoom ratio.
Shutter	Electronic shutter is used to control exposure times.

The effect of image taking conditions on image quality

There are some factors, which may cause poor image quality, if not taken into account by the end user when shooting images, and thus may result in complaints. The items listed are normal to camera operation and are not a reason for changing the camera module.

The amount of light available

In dim conditions camera runs out of sensitivity. The exposure time is long (especially in the night mode) and the risk of getting shaken (= blurred) images increases.

In addition, image noise level grows. The maximum exposure time in the night mode is ¼ seconds.

Therefore, images need to be taken with extreme care and by supporting the phone when the amount of light reflected from the target is low.

Because of the longer exposure time and larger gain value, noise level increases in low light conditions.

Sometimes blurring may even occur in daytime, if the image is taken very carelessly. See the figure below for an example. This is normal; do not change the camera module.

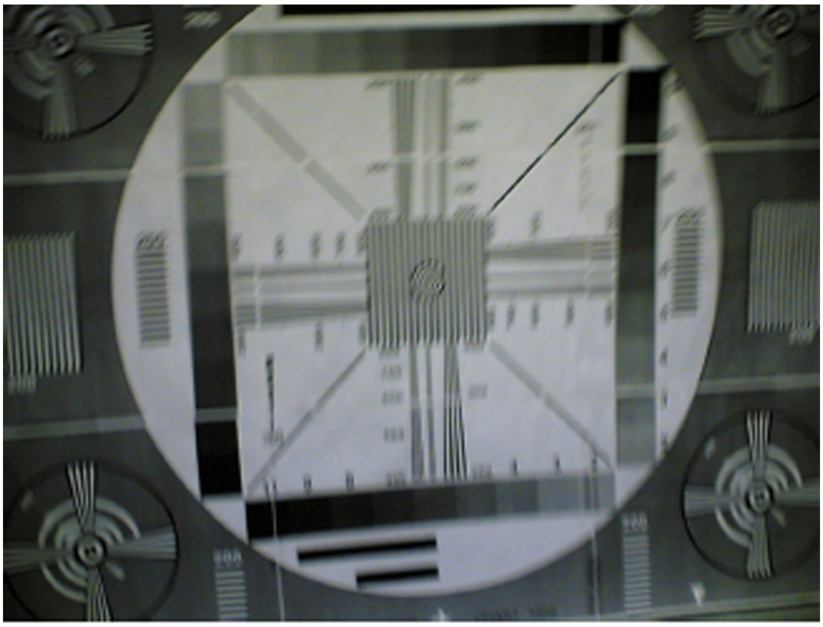


Figure 21 Blurring caused by shaking hands

Movement in bright light

If an image is taken of moving objects or if the device is used in a moving vehicle, object 'skewing' or 'tilting' may occur.

This phenomenon is fundamental to most CMOS camera types, and may happen when using the electronic shutter.

The movement of camera or object sometimes cause blurring indoors or in dim lighting conditions because of long exposure time. This is normal; do not change the camera module.

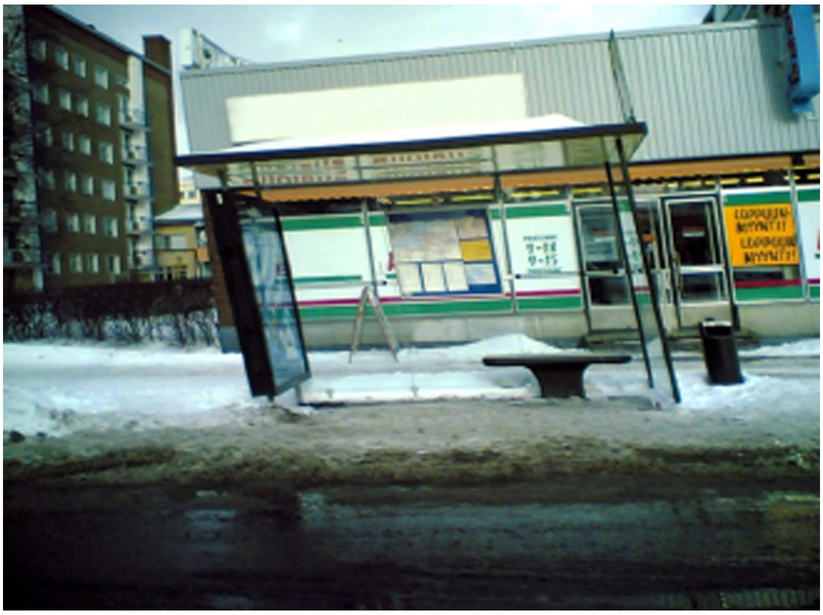


Figure 22 Near objects get skewed when taking images from a moving vehicle

Temperature

High temperatures inside the mobile phone cause more noise to appear in images. For example, in +70 degrees (Celsius), the noise level may be very high, and it further grows if the conditions are dim.

If the phone processor has been heavily loaded for a long time before taking an image, the phone might have considerably higher temperature inside than in the surrounding environment. This is also normal to camera operation; do not change the camera module.

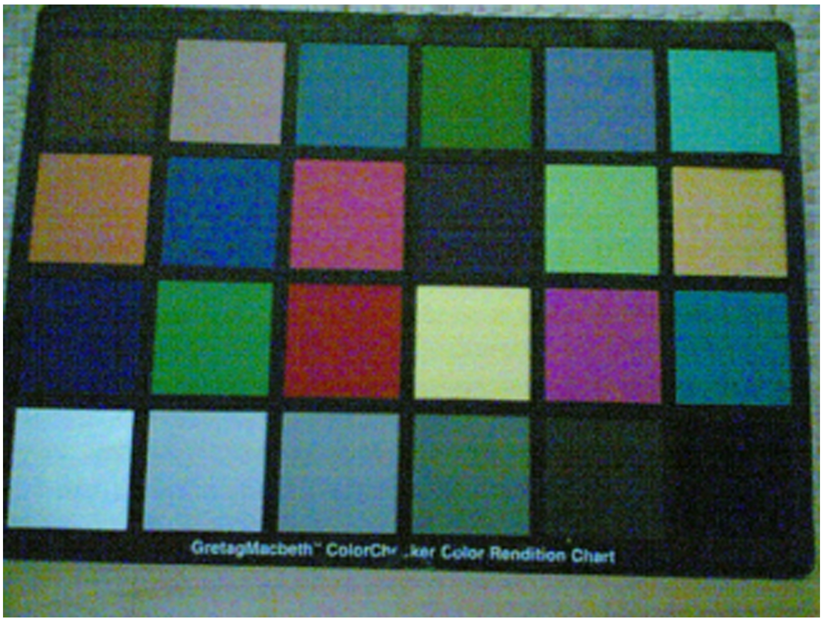


Figure 23 Noisy image taken in +70 degrees Celsius

Phone display

If the display contrast is set too dark, the image quality degrades: the images may be very dark depending on the setting. If the display contrast is set too bright, image contrast appears bad and "faint". This problem is solved by setting the display contrast correctly. This is normal behaviour; do not change the camera module.

Basic rules of photography (especially shooting against light)

Because of dynamic range limitations, taking images against bright light might cause either saturated image or the actual target appear too dark.

In practice, this means that when taking an image indoors and having, for example, a window behind the object, the result is usually poor. This is normal behaviour; do not change the camera module.

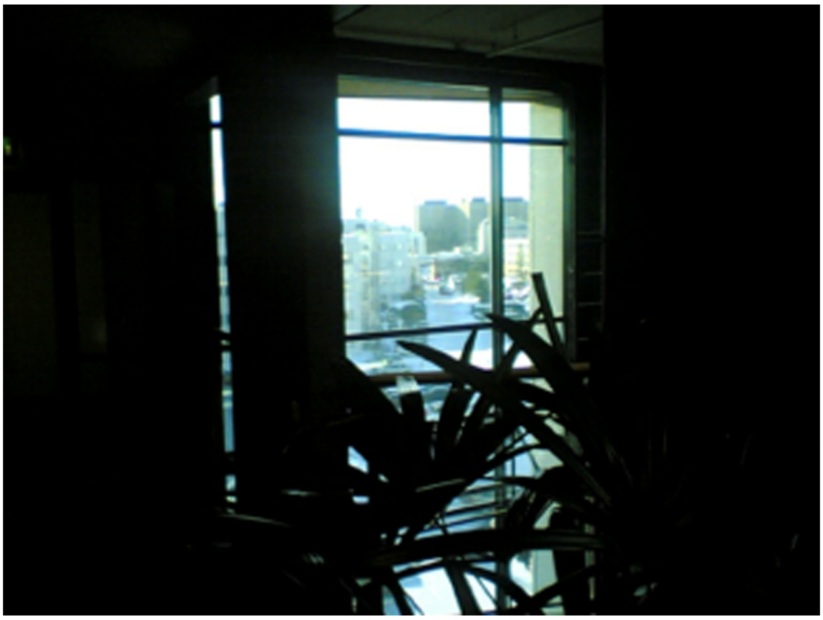


Figure 24 Image taken against light

Flicker

In some occasions a bright fluorescent light may cause flicker in the viewfinder and captured image. This phenomenon may also be a result, if images are taken indoors under the mismatch of 50/60 Hz electricity network frequency.

The electricity frequency used is automatically detected by the camera module. In some very few countries, both 50 and 60 Hz networks are present and thus probability for the phenomenon increases.

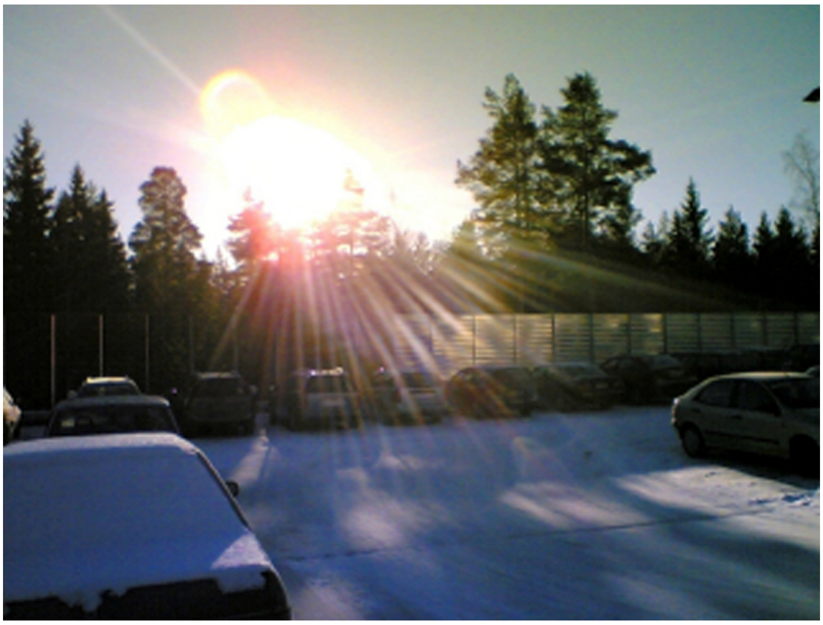
Flickering occurs also under high artificial illumination level. Flickering only occurs when the rolling shutter is used. This is normal behaviour; do not change the camera module.

Figure 25 Flicker in an image; object illuminated by strong fluorescent light

Bright light outside of image view

Especially the sun can cause clearly visible lens glare phenomenon and poor contrast in images. This happens because of undesired reflections inside the camera optics.

Generally this kind of reflections are common in all optical systems. This is normal behaviour; do not change the camera module.



Examples of good quality images

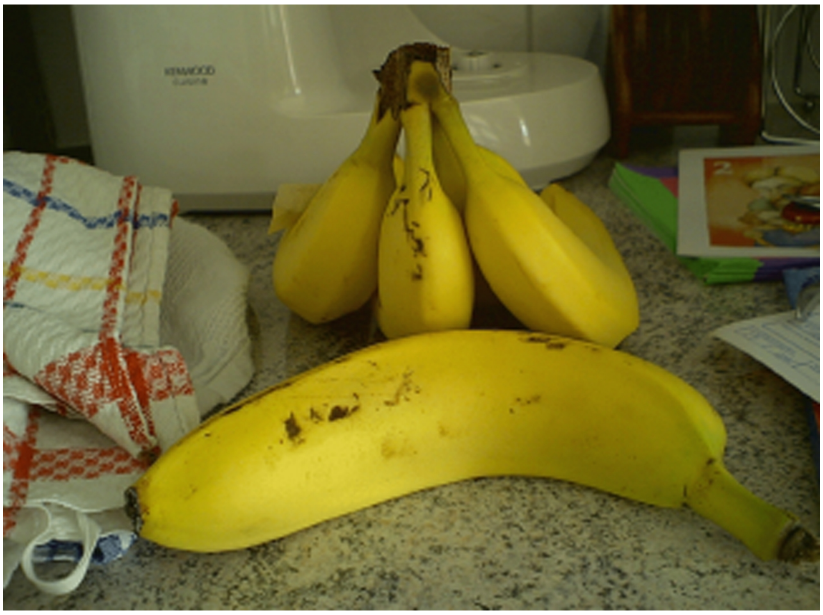


Figure 26 Good image taken indoors

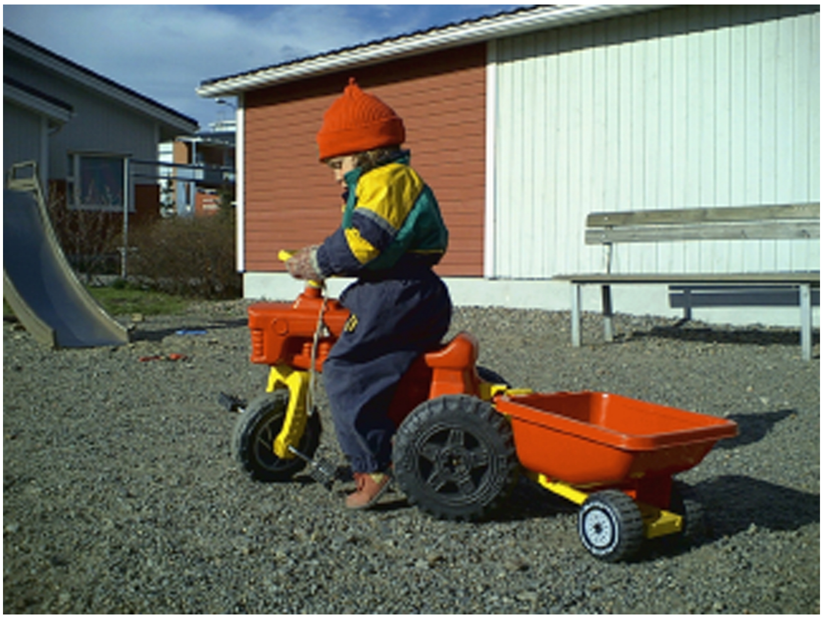


Image quality analysis

Possible faults in image quality

When checking for possible errors in camera functionality, knowing what error is suspected significantly helps the testing by narrowing down the amount of test cases. The following types of image quality problems may be expected to appear:

- Dust (black spots)
- Lack of sharpness
- Bit errors

In addition, there are many other kinds of possibilities for bad image quality, but those are ruled out from the scope of this document since the probability of their appearance is small.

Testing for dust in camera module

Symptoms and diagnosis

For detecting these kinds of problems, take an image of a uniform white surface and analyse it in full resolution. A good quality PC monitor is preferred for analysis. Search carefully, since finding these defects is not always easy. Figure "Effects of dust on optical path" is an example image containing easily detectable dust problems.

When taking a white image, use uniformly lightened white paper or white wall. One possibility is to use uniform light but in this case make sure that the camera image is not flickering when taking the test image. In case flickering happens, try to reduce illumination level. Use JPEG image format for analysing, and set the image quality parameter to ‘High Quality’.

Black spots in an image are caused by dirt particles trapped inside the optical system. Clearly visible and sharp edged black dots in an image are typically dust particles on the image sensor. These spots are searched for in the manufacturing phase, but it is possible that the camera body cavity contains a particle, which may move onto the image sensor active surface, for example, when the phone is dropped. Thus it is also possible that the problem will disappear before the phone is brought to service. The camera should be replaced if the problem is present when the service technician analyses the phone.

If a dust particle is lying on the infrared filter surface on either side, they are hard to locate because they are out of focus, and appear in the image as large, grayish and fading-edge 'blobs'. Sometimes they are invisible to the eye, and thus the user probably does not notice them at all. However, it is possible that a larger particle disturbs the user, causing need for service.

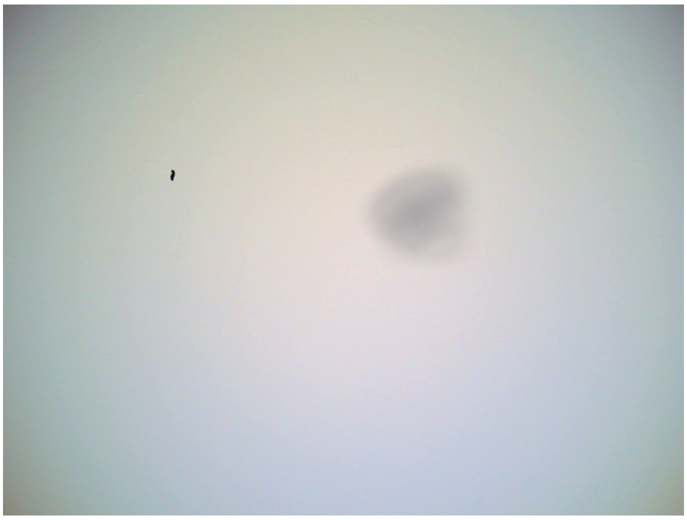


Figure 27 Effects of dust on optical path

If large dust particles get trapped on top of the lens surface in the cavity between camera window and lens, they will cause image blurring and poor contrast. The dust gasket between the window and lens should prevent any particles from getting into the cavity after the manufacturing phase.

If dust particles are found on the sensor, this is classified as a manufacturing error of the module and the camera should be replaced. Any particles inside the cavity between the protection window and lens have most probably been trapped there in the assembly phase at a Nokia factory. Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial. Always check the image sharpness after removing dust.

Testing camera image sharpness

Symptoms and diagnosis

If pictures taken with a device are claimed to be blurry, there are five possible sources for the problem:

1. The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.
2. The camera module has failed to focus correctly, producing a blurred image.
3. User has tried to take pictures in too dark conditions and images are blurred due to handshake or movement. This is not a cause to replace camera module.
4. There is dirt between the protection window and the camera lens.
5. The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

A quantitative analysis of sharpness is very difficult to conduct in any other environment than optics laboratory. Therefore, subjective analysis should be used.

If no visible defects (items 1-4) are found, a couple of test images should be taken. Generally, a well-illuminated typical indoor scene, such as the one in Figure "Good image taken indoors", can be used as a target. The main considerations are:

- The camera module has to be given time to focus correctly. Correct focusing is normally indicated with a flashing icon or green bracket in the viewfinder. During focusing, the image in the viewfinder moves slightly back and fourth, this is normal and shows that the lens unit is moving. During the movement a faint sound can be heard from the camera head.
- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

The taken images should be analysed on PC screen at 100% scaling simultaneously with a reference image. Pay attention to the computer display settings; at least 65000 colors (16 bit) have to be used. 256 (8-bit) color setting is not sufficient; true color (24 bit, 16 million colors) or 32 bit (full color) setting is recommended.

If the differences are noticeable at a glance and also if the one under investigation is significantly inferior, the module might have a faulty lens. In this case, the module should be changed. Always recheck the resolution after changing the camera module. If a different module produces a clearly noticeable quality gap, the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module. As references Figure "Good image taken indoors" and Figure "Good image taken outdoors" can be used. Another possibility is to use a service point comparison phone, if available.

Effects of dirty or defective camera lens protection window

The following series of images demonstrates the effects of fingerprints on the camera protection window.

> **Note:** The effects of any dirt in images can vary very much; it may be difficult to judge if the window has been dirty when some image has been taken or if something else has been wrong. That is why the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

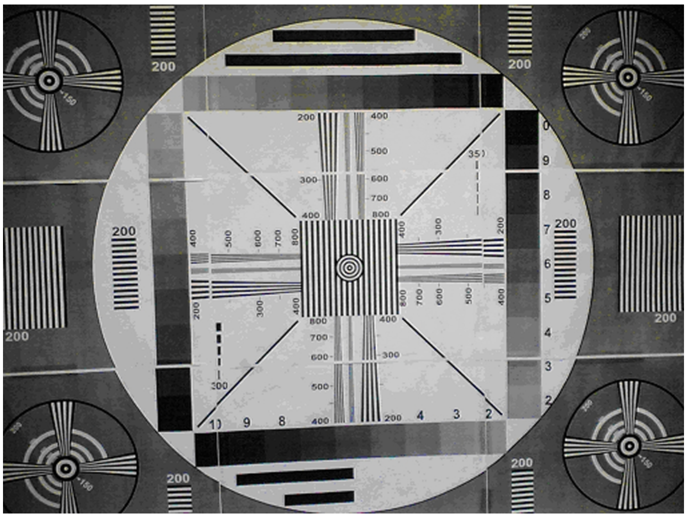


Figure 28 Image taken with clear protection window

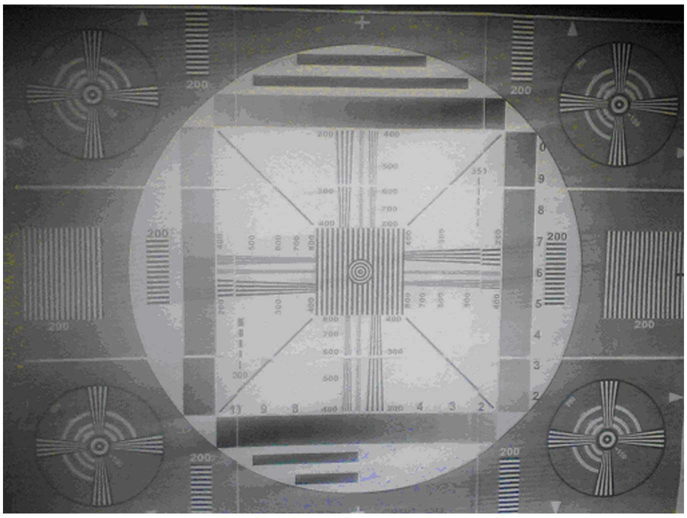


Figure 29 Image taken with greasy protection window

Bright point light sources might cause images that have flares around the light source if the protection window is dirty. A smeared fingerprint may be hard to see on the protective window but if will affect the image quality. These flares can be avoided by cleaning the window with a suitable cloth.

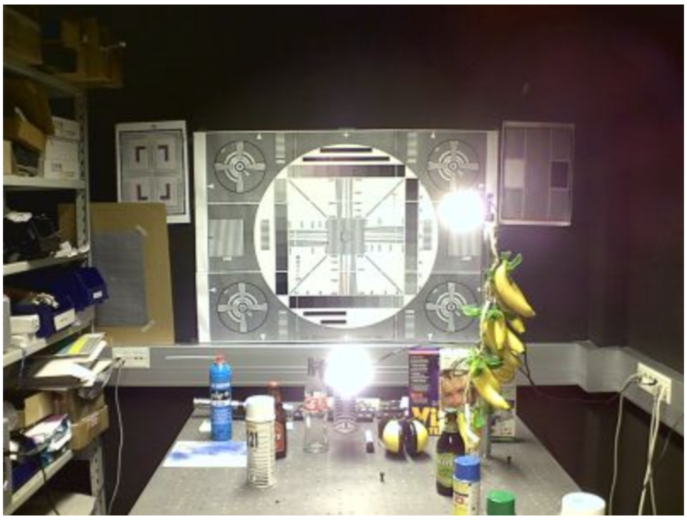


Figure 30 Image of point light sources taken with a clean protective window

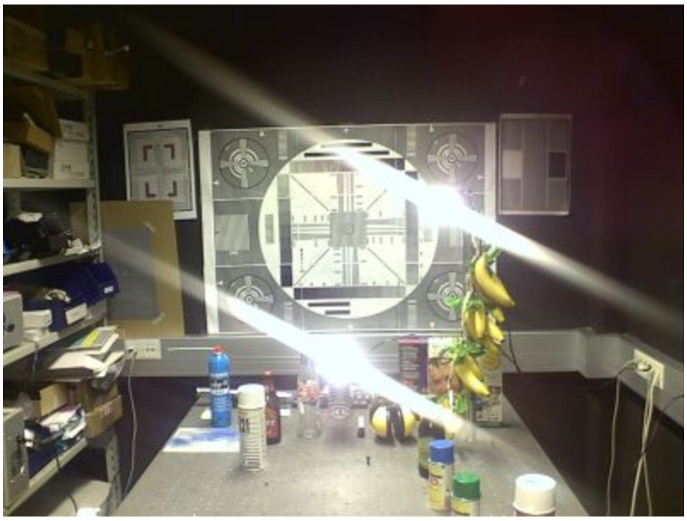


Figure 31 Image of point light sources taken with a dirty (finger print) protective window

Faulty pixels in images

Faulty pixels are pixels that do not respond to light in the same way as the pixels around them. There are three main types of faulty pixels, dead, stuck and hot pixels.

Dead pixels are always black or significantly darker than their surrounding. Dead pixels appear as black spots in all lightning conditions. Camera modules producing images with dead pixels that are clearly noticeable should be replaced.

If the pixel remains always saturated to its maximum value it is stuck. Stuck pixels may appear as red, green, blue or white spots in all lightning conditions. Camera modules producing images with one or more stuck pixels should be replaced.

Hot pixels are pixels that easily saturate in dim light conditions. It is normal to get a lot of noise and hot pixels in night conditions or otherwise dark conditions. The hot pixels should disappear when the ambient light is increased, but may still appear in darker areas of an otherwise well illuminated scene.

When examining an image for defect pixels, test images should be viewed as 100% enlargements on a PC monitor.

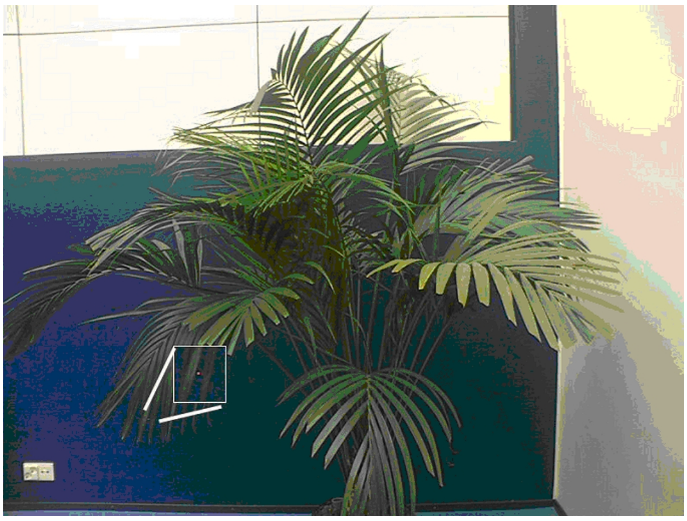


Figure 32 Enlargement of a hot pixel

Flash photography problems

Use of flash device may affect the image in many ways.

- White balance errors. The image may get a wrong tone due to mixing of flash colour temperature and ambient lightning. This is unwanted but normal feature.
- Dust reflections. Dust or water drops in front of the flash unit may reflect strongly to the camera sensor. See the following figure.

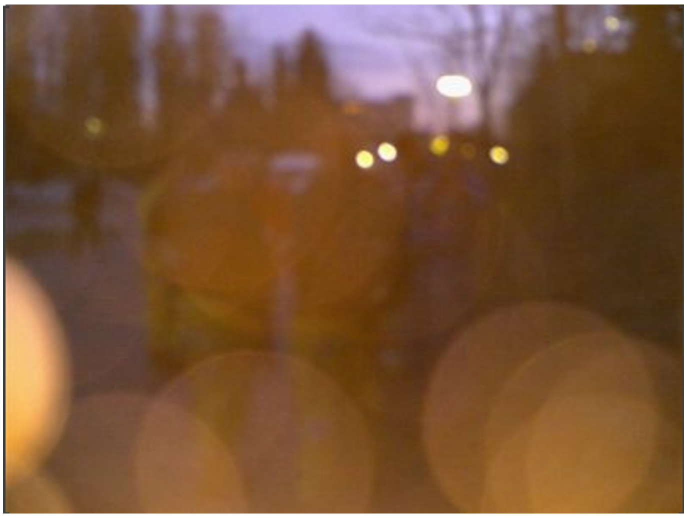
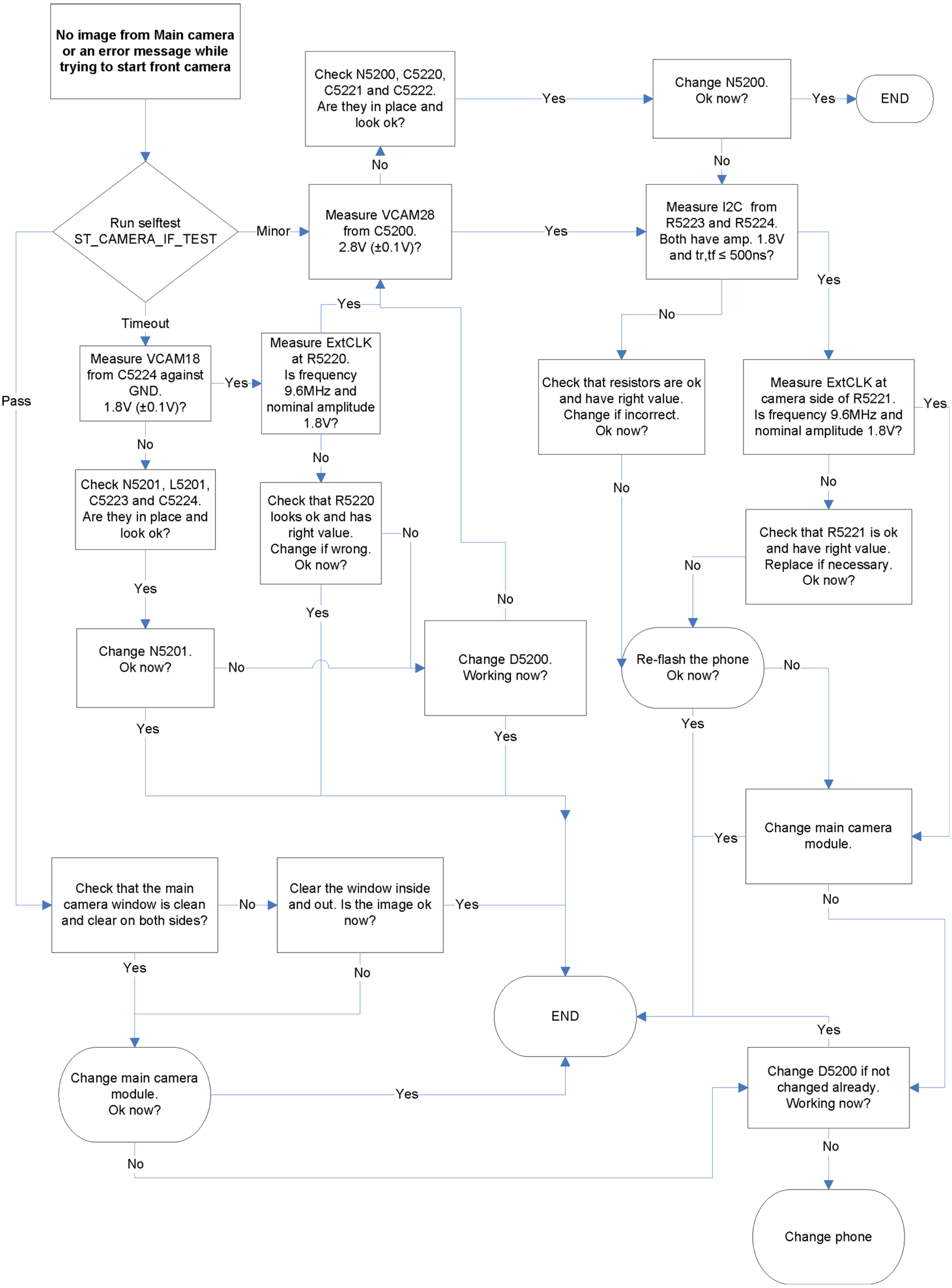


Figure 33 Light from the flash has reflected on particles in front of the camera

Main camera troubleshooting flowcharts

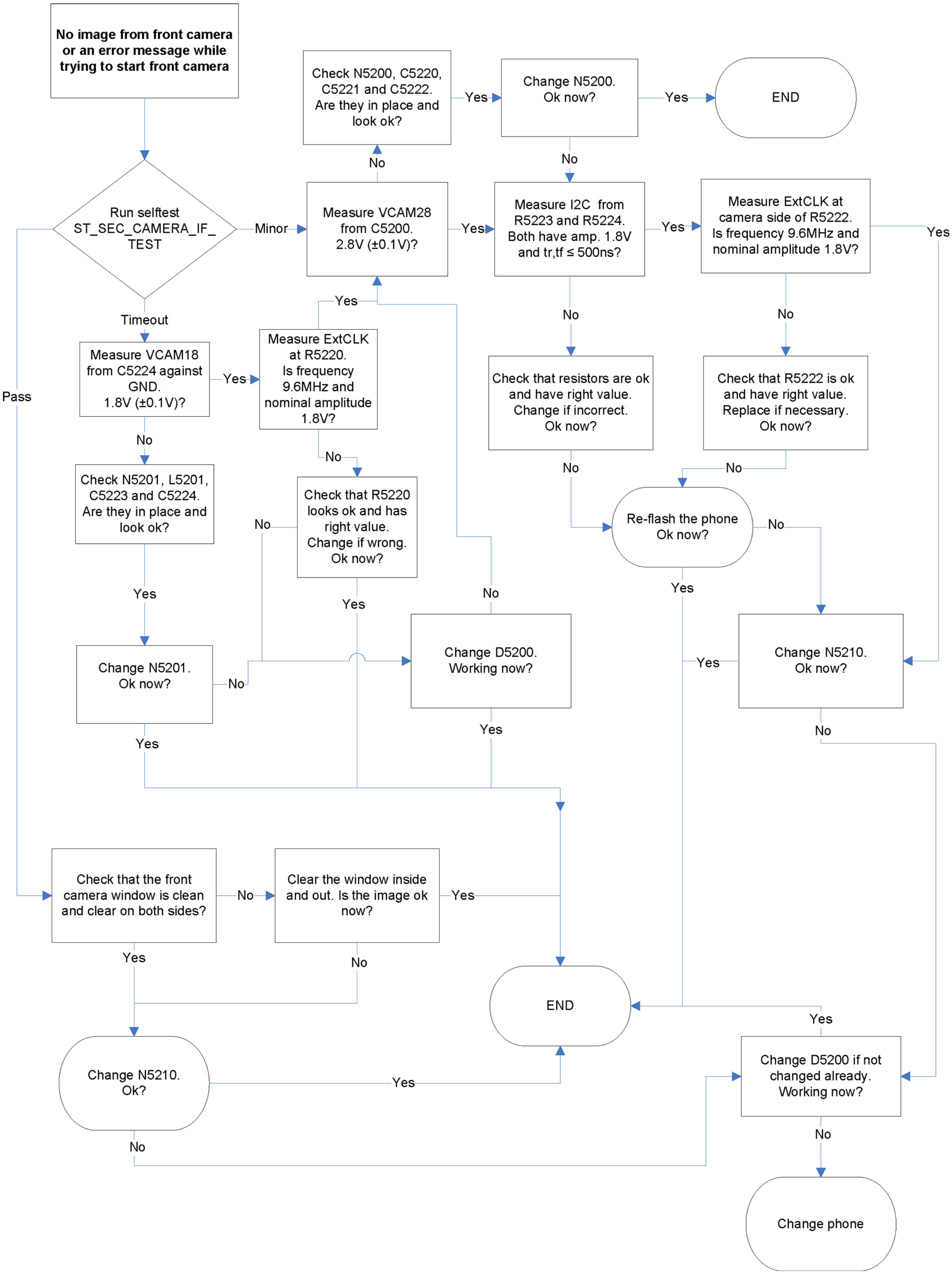
Main camera troubleshooting

Troubleshooting flow


No image from Main camera or an error message while trying to start front camera
Run selftest ST_CAMERA_IF_TEST
Minor
Timeout
Pass
Measure VCAM28 from C5200. 2.8V (±0.1V)?
Check N5200, C5220, C5221 and C5222. Are they in place and look ok?
Change N5200. Ok now?
END
Measure I2C from R5223 and R5224. Both have amp. 1.8V and tr,tf ≤ 500ns?
Measure VCAM18 from C5224 against GND. 1.8V (±0.1V)?
Measure ExtCLK at R5220. Is frequency 9.6MHz and nominal amplitude 1.8V?
Check N5201, L5201, C5223 and C5224. Are they in place and look ok?
Check that R5220 looks ok and has right value. Change if wrong. Ok now?
Change N5201. Ok now?
Change D5200. Working now?
Check that resistors are ok and have right value. Change if incorrect. Ok now?
Measure ExtCLK at camera side of R5221. Is frequency 9.6MHz and nominal amplitude 1.8V?
Check that R5221 is ok and have right value. Replace if necessary. Ok now?
Re-flash the phone Ok now?
Change main camera module.
Check that the main camera window is clean and clear on both sides?
Clear the window inside and out. Is the image ok now?
END
Change main camera module. Ok now?
Change D5200 if not changed already. Working now?
Change phone
Yes
No

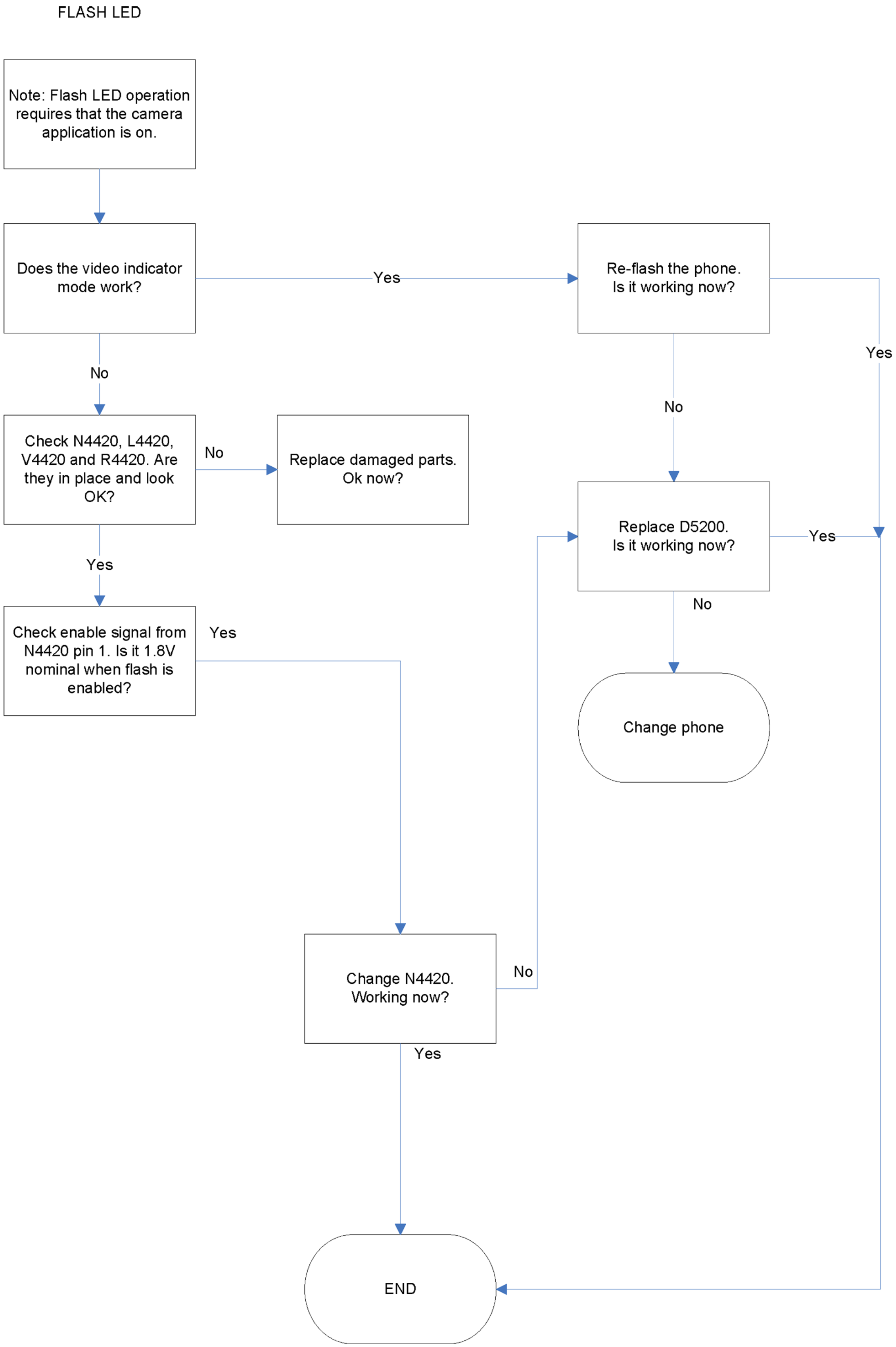
Secondary camera troubleshooting

Troubleshooting flow


No image from front camera or an error message while trying to start front camera
Run selftest ST_SEC_CAMERA_IF_TEST
Pass
Minor
Timeout
Measure VCAM28 from C5200. 2.8V (±0.1V)?
Check N5200, C5220, C5221 and C5222. Are they in place and look ok?
Change N5200. Ok now?
END
Measure I2C from R5223 and R5224. Both have amp. 1.8V and tr,tf ≤ 500ns?
Measure ExtCLK at camera side of R5222. Is frequency 9.6MHz and nominal amplitude 1.8V?
Measure VCAM18 from C5224 against GND. 1.8V (±0.1V)?
Measure ExtCLK at R5220. Is frequency 9.6MHz and nominal amplitude 1.8V?
Check that resistors are ok and have right value. Change if incorrect. Ok now?
Check that R5222 is ok and have right value. Replace if necessary. Ok now?
Check N5201, L5201, C5223 and C5224. Are they in place and look ok?
Check that R5220 looks ok and has right value. Change if wrong. Ok now?
Re-flash the phone Ok now?
Change N5201. Ok now?
Change D5200. Working now?
Change N5210. Ok now?
Check that the front camera window is clean and clear on both sides?
Clear the window inside and out. Is the image ok now?
END
Change N5210. Ok?
Change D5200 if not changed already. Working now?
Change phone
Yes
No

Flash LED troubleshooting

Troubleshooting flow


FLASH LED
Note: Flash LED operation requires that the camera application is on.
Does the video indicator mode work?
Yes
Re-flash the phone. Is it working now?
Yes
No
No
Check N4420, L4420, V4420 and R4420. Are they in place and look OK?
No
Replace damaged parts. Ok now?
Replace D5200. Is it working now?
Yes
Yes
No
Check enable signal from N4420 pin 1. Is it 1.8V nominal when flash is enabled?
Yes
Change phone
Change N4420. Working now?
No
Yes
END

6 — TV troubleshooting

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Service instructions

Service instructions for DVB-H repairs

Note: Please see service concept from the Service tools and service concept (page) chapter.

DVB-H setup and self test

Setup for DVB-H Self test

Steps

1. Connect the phone to setup with product specific adapter FS-46.
2. Start Phoenix and set Operation mode to **Local**
3. Provide SW update

DVB-H Self test

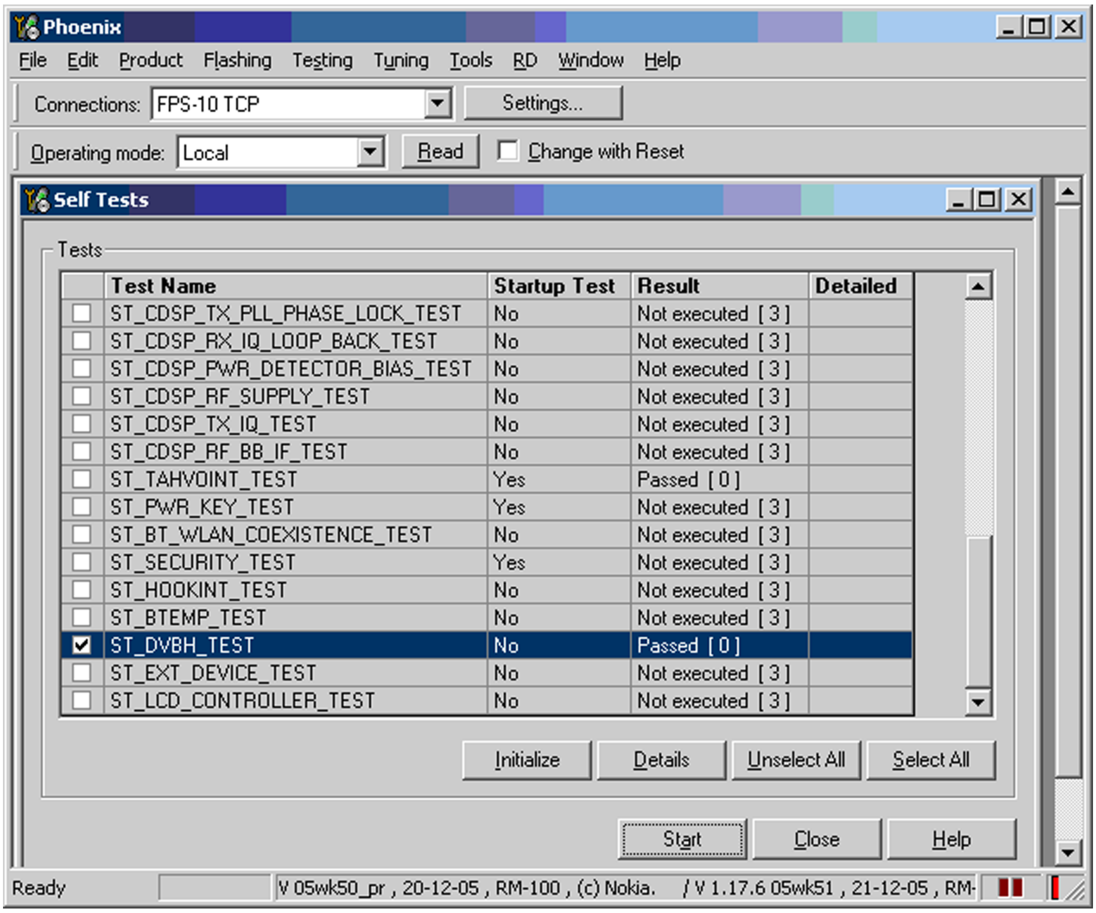
Prerequisites

Run DVB-H Selftest in Phoenix (Selftest UI not available with FLS-4S. With FLS-5 the Selftest UI is available.)

Steps

1. From the **File** choose **Scan Product** .
2. From **Testing** menu select **Self Test**.
3. Select **ST_DVB-H_TEST box** (see figure below).

4. Press **Start**. The result can be seen from **Result** column.


Phoenix
File Edit Product Flashing Testing Tuning Tools RD Window Help
Settings...
Read
Self Tests
Tests
Initialize
Details
Unselect All
Select All
Start
Close
Help

Connections: FPS-10 TCP

Operating mode: Local

☐ Change with Reset

	Test Name	Startup Test	Result	Detailed
☐	ST_CDSP_TX_PLL_PHASE_LOCK_TEST	No	Not executed [3]	
☐	ST_CDSP_RX_IQ_LOOP_BACK_TEST	No	Not executed [3]	
☐	ST_CDSP_PWR_DETECTOR_BIAS_TEST	No	Not executed [3]	
☐	ST_CDSP_RF_SUPPLY_TEST	No	Not executed [3]	
☐	ST_CDSP_TX_IQ_TEST	No	Not executed [3]	
☐	ST_CDSP_RF_BB_IF_TEST	No	Not executed [3]	
☐	ST_TAHVOINT_TEST	Yes	Passed [0]	
☐	ST_PWR_KEY_TEST	Yes	Not executed [3]	
☐	ST_BT_WLAN_COEXISTENCE_TEST	No	Not executed [3]	
☐	ST_SECURITY_TEST	Yes	Not executed [3]	
☐	ST_HOOKINT_TEST	No	Not executed [3]	
☐	ST_BTEMP_TEST	No	Not executed [3]	
☑	ST_DVBH_TEST	No	Passed [0]	
☐	ST_EXT_DEVICE_TEST	No	Not executed [3]	
☐	ST_LCD_CONTROLLER_TEST	No	Not executed [3]	

Ready | V 05wk50_pr , 20-12-05 , RM-100 , (c) Nokia. / V 1.17.6 05wk51 , 21-12-05 , RM-

5. Follow the **DVB-H troubleshooting flowchart**.

Table 16 Pass/Fail Failure codes

Result	Description	Action
0x1	Self test failed.	Replace DVB-H Module.
0xFD(-3)	No connection to DVB-H Module.	-
0xF2(-14)	Another test is ongoing.	Restart the phone and run the self test again.

DVB-H RF test measurement

Galvanic DVB-H RF test measurement with FS-46

Note: Setup: PC/Phoenix/FLS-5/SS-46/FS-46 with integrated galvanic RF/SMA connector + signal generator

Steps

1. Setup the FS-46 with connector and generator.

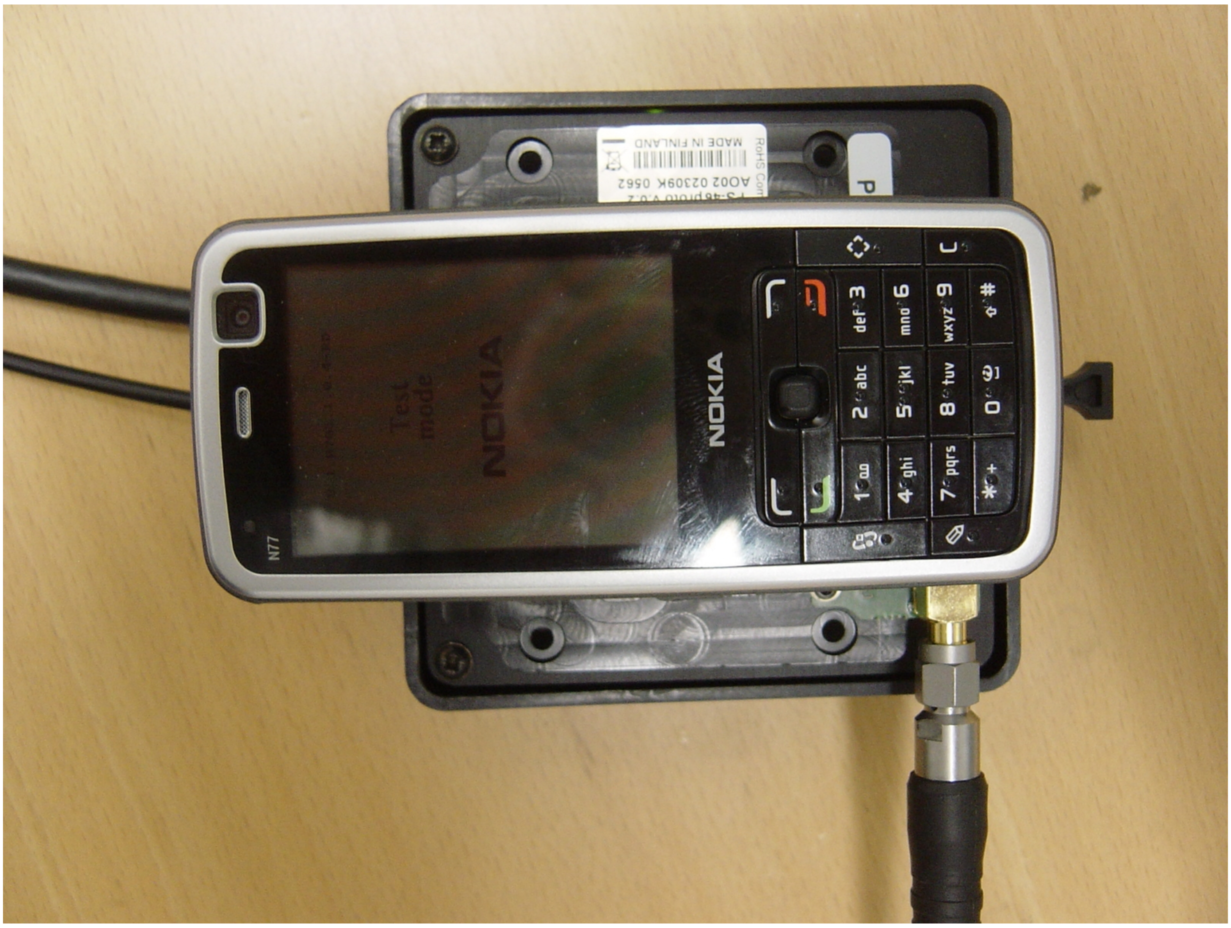
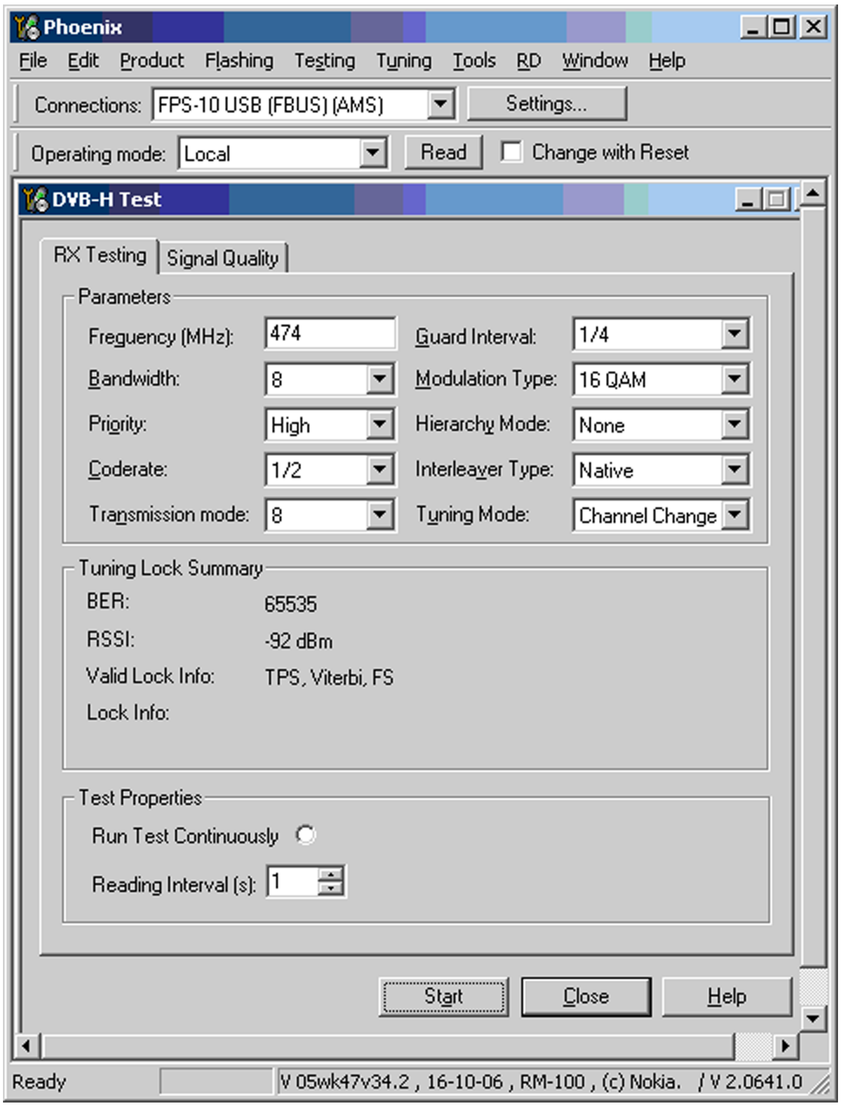


Figure 34 Setup of FS-46 with connector and signal generator

2. Set the frequency in the signal generator to 475 MHz.
3. Set the output level (amplitude) of the signal generator to -30 dBm.
4. Set the frequency in the RX Testing field in Phoenix to 474 MHz (test window in the following figure).
5. Press the start button (see picture below).
6. Monitor the RSSI value in the Tuning Lock Summary field (see figure).

7. CW test result -> **RSSI reading** -> The RSSI value should be within limits given in the following table.


Phoenix
File Edit Product Flashing Testing Tuning Tools RD Window Help
Settings...
Read
DVB-H Test
RX Testing
Signal Quality
Parameters
Tuning Lock Summary
Test Properties
Start
Close
Help

Connections: FPS-10 USB (FBUS) (AMS)
Operating mode: Local
☐ Change with Reset

Frequency (MHz): 474
Bandwidth: 8
Priority: High
Coderate: 1/2
Transmission mode: 8
Guard Interval: 1/4
Modulation Type: 16 QAM
Hierarchy Mode: None
Interleaver Type: Native
Tuning Mode: Channel Change

BER: 65535
RSSI: -92 dBm
Valid Lock Info: TPS, Viterbi, FS
Lock Info:

Run Test Continuously ○
Reading Interval (s): 1

Ready
V 05wk47v34.2 , 16-10-06 , RM-100 , (c) Nokia. / V 2.0641.0

Figure 35 Phoenix DVB-H testing window

Note: CW test result -> RSSI reading ("Signal Quality" feature is not needed).

8. Run DVB-H RX Test also with frequencies 610 MHz and 746 MHz according to following table.

Table 17 Setup and target test values

Frequency	Signal level	RSSI value	Tolerance
474	-30 dBm	-55dBm	+/-3dBm
610	-30 dBm	-53dBm	+/-3dBm
746	-30 dBm	-48dBm	+/-3dBm

Note: Frequency in the table is typed in DVB-H Test/Frequency field. Set signal generator frequency always 1 MHz higher.

Galvanic DVB-H RF test measurement with module jig

Note: If the RSSI value is to be checked also from the RF connector, the procedure is as described in the step list above except that the RSSI value is more accurate i.e. with signal level -40dBm the value measured should be -40 dBm (±3dBm).

Steps

1. Disassemble the phone.
2. Place disassemble phone to module jig.

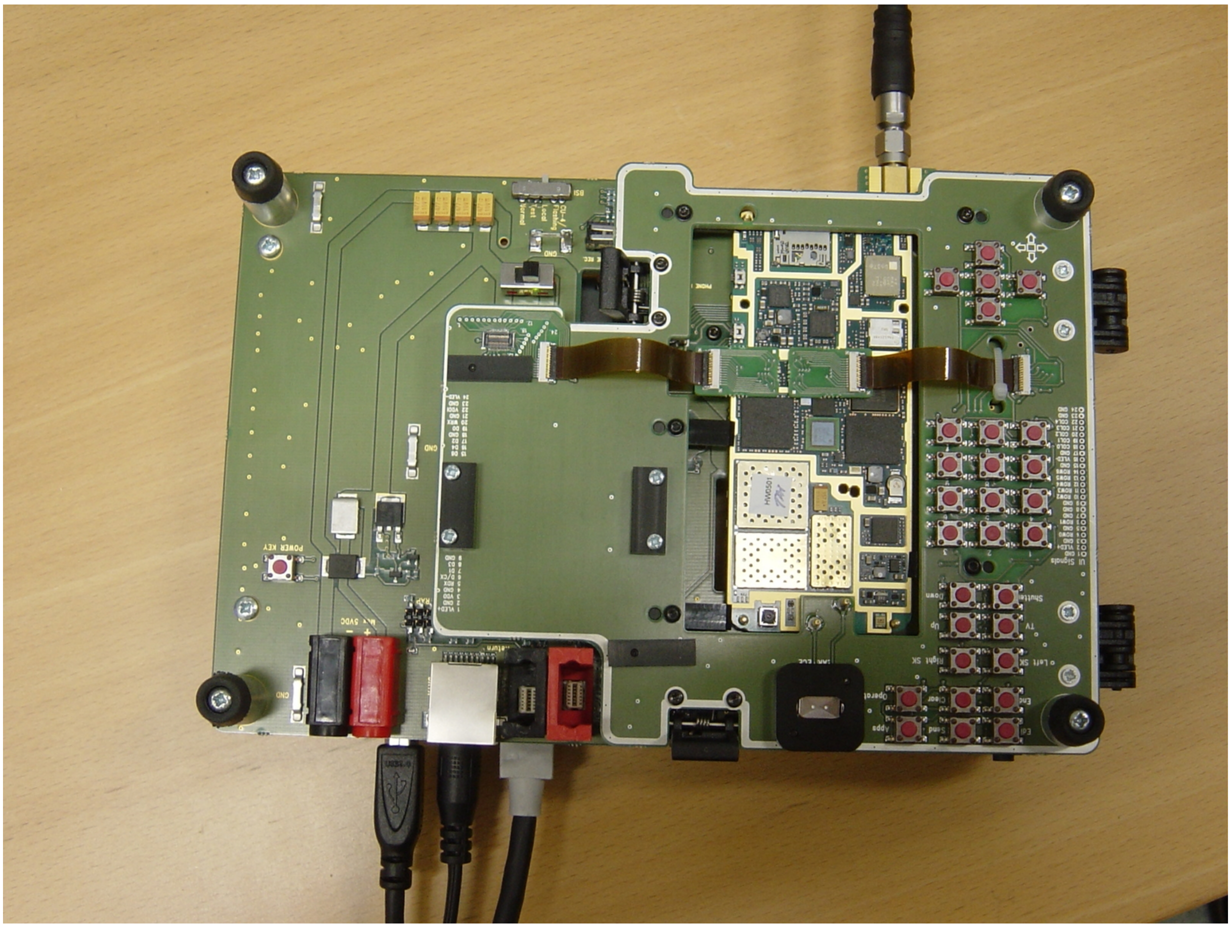


Figure 36 Phone disassembled and placed to jig

3. Connect cables to the jig.
4. Connect cable from **Signal Generator** to **Module Jig DVB-H SMA connector**.
5. Proceed the steps 2-8 according to chapter **Galvanic DVB-H RF test measurement with FS-46**.

RM-194 DVB-H engine R5 measurement guide

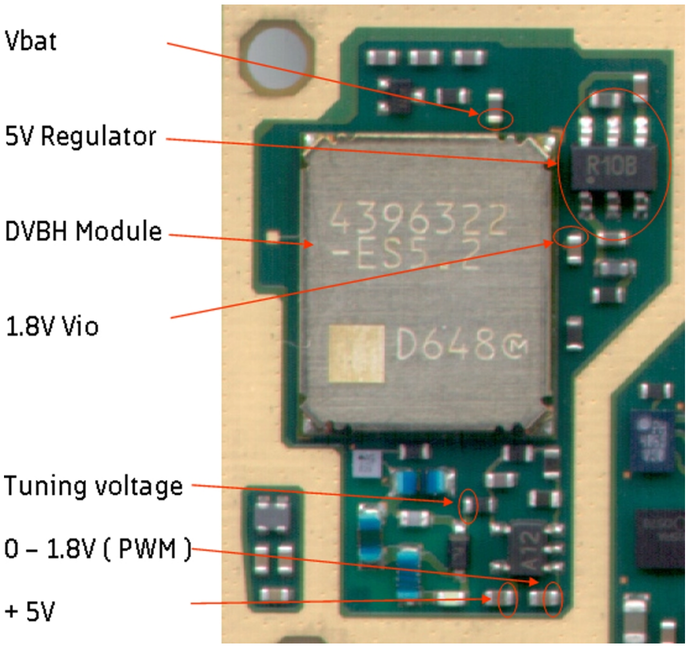


Figure 37 RM-194 layout

Vbat

- should be 3.0 ... 4.2V
- in module jig it should be 3.7V
- in case the voltage is not within limits, there is a ‘general’ failure, short circuit etc. somewhere in the phone

1.8V Vio

- supplied by ASIC
- should be about 1.8 V (+/- 10%)
- if missing, general failure in phone

+5V

- should be 4.5 ... 5.5V
- supplied by 5V regulator
- if missing, failure in regulator or surrounding component or in tuning voltage amplifier
- before next step the DVB-H engine Test -> RX test dialogue must be used to set the DVB-H engine Engine to a certain frequency i.e. 474 MHz

Tuning voltage

- measure the voltage after DVB-H engine set to frequency

  if missing i.e. voltage is 0V, measure the PWM also
- voltage depends on the frequency:
  - 474 MHz – 0.7V
  - 610 MHz – 2.8V

  - 746 MHz – 4.7V
- if missing i.e. voltage is 0V, measure the PWM also

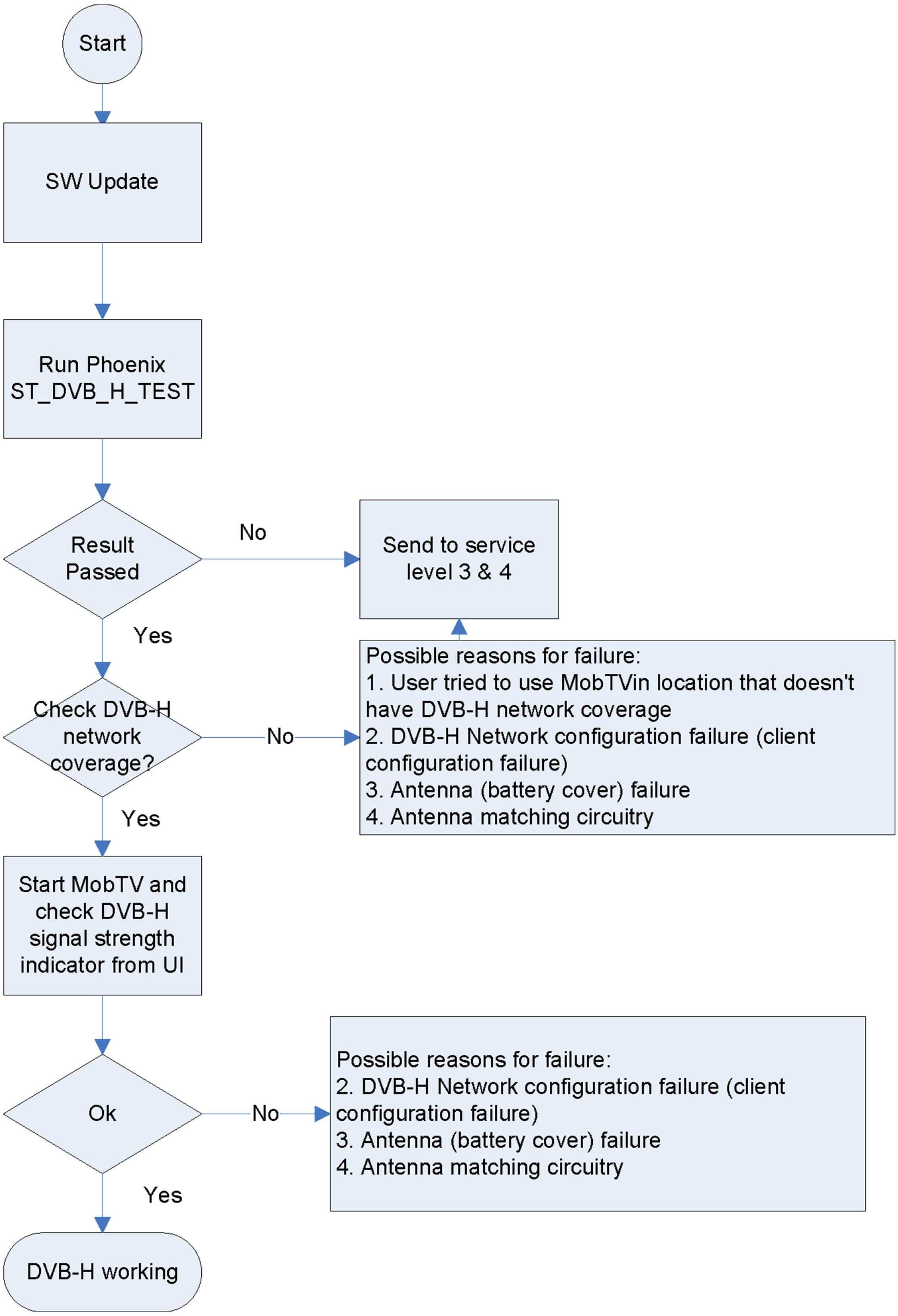
PWM

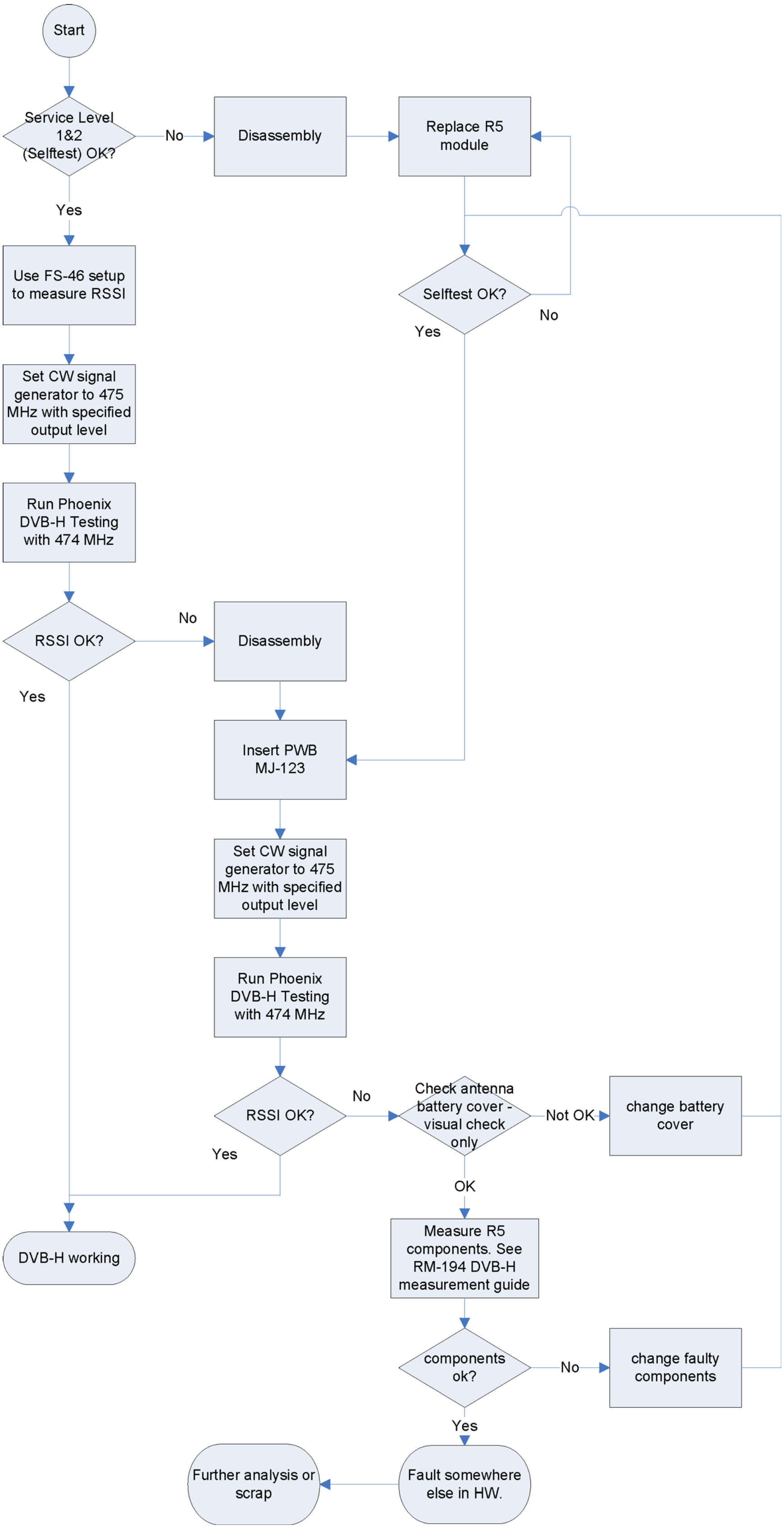
- voltage depends on the frequency:
  - 474 MHz – 0.23V
  - 610 MHz – 0.93V
  - 746 MHz – 1.57V

DVB-H troubleshooting

DVB-H troubleshooting

Troubleshooting flow


Start
SW Update
Run Phoenix ST_DVB_H_TEST
Result Passed
No
Send to service level 3 & 4
Yes
Possible reasons for failure:
1. User tried to use MobTVin location that doesn't have DVB-H network coverage
2. DVB-H Network configuration failure (client configuration failure)
3. Antenna (battery cover) failure
4. Antenna matching circuitry
Check DVB-H network coverage?
No
Yes
Start MobTV and check DVB-H signal strength indicator from UI
Ok
No
Possible reasons for failure:
2. DVB-H Network configuration failure (client configuration failure)
3. Antenna (battery cover) failure
4. Antenna matching circuitry
Yes
DVB-H working


Start
Service Level 1&2 (Selftest) OK?
No
Disassembly
Replace R5 module
Yes
Use FS-46 setup to measure RSSI
Selftest OK?
No
Yes
Set CW signal generator to 475 MHz with specified output level
Run Phoenix DVB-H Testing with 474 MHz
RSSI OK?
No
Disassembly
Yes
Insert PWB MJ-123
Set CW signal generator to 475 MHz with specified output level
Run Phoenix DVB-H Testing with 474 MHz
RSSI OK?
No
Check antenna battery cover - visual check only
Not OK
change battery cover
Yes
OK
DVB-H working
Measure R5 components. See RM-194 DVB-H measurement guide
components ok?
No
change faulty components
Yes
Further analysis or scrap
Fault somewhere else in HW.

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7 — System Module

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Baseband description

System module block diagram

The device consists of two different main modules: transceiver and UI. The transceiver board consists of baseband and RF components. The UI board consists of key domes and keypad backlights. Connection between the UI and the transceiver board is established via a board-to-board spring connector.

Baseband functional description

Digital baseband consists of an ISA (Intelligent Software Architecture) based modem and Symbian based application sections. The modem functionality is in RAP, and the application processor acts as a platform for Symbian applications. The terms ISA and Symbian are used refer to the software environment of these devices.

The modem section consists of a RAP ASIC with NOR FLASH and SDRAM memory as the core. RAP supports WCDMA and GSM cellular protocols. The modem DDR SDRAM memory has 128 Mbits of memory and NOR flash has 128 Mbits of memory. RAP operates with the system clock of 38.4 MHz, which comes from the VCTCXO.

The application section includes an application processor ASIC with DDR/NAND combo memory as the core.

Application processor

The application processor is also called an application ASIC because it is processing application SW and handles the UI SW. It consists of the application processor and peripheral subsystems such as camera, display and keyboard driver blocks.

Absolute maximum ratings

Signal	Min	Nom	Max	Unit	Notes
Battery voltage (idle)	-0.3		+4.5	V	Battery voltage maximum value is specified during charging is active
Battery voltage (Call)	+3.2		+4.3	V	Battery voltage maximum value is specified during charging is active
Charger input voltage	-0.3		+20	V	
Back-Up supply voltage	0	2.5	2.6	V	Maximum capacity of the backup power supply 4 µAh.

Phone modes of operation

Mode	Description
NO_SUPPLY	(dead) mode means that the main battery is not present or its voltage is too low (below EM ASIC N2200 master reset threshold) and that the back-up battery voltage is too low.
BACK_UP	The main battery is not present or its voltage is too low but back-up battery voltage is adequate and the 32 kHz oscillator is running (RTC is on).
PWR_OFF	In this mode (warm), the main battery is present and its voltage is over EM ASIC N2200 master reset threshold. All regulators are disabled, PurX is on low state, the RTC is on and the oscillator is on. PWR_OFF (cold) mode is almost the same as PWR_OFF (warm), but the RTC and the oscillator are off.

Mode	Description
RESET	RESET mode is a synonym for start-up sequence. In this mode certain regulators are enabled and after they and RFClk have stabilized, the system reset (PurX) is released and PWR_ON mode entered. RESET mode uses 32 kHz clock to count the REST mode delay (typically 16 ms).
SLEEP	SLEEP mode is entered only from PWR_ON mode with the aid of SW when the system's activity is low.
FLASHING	FLASHING mode is for SW downloading.

Voltage limits

Parameter	Description	Value
VMSTR	Master reset threshold (N2200)	2.2 V (typ.)
VMSTR+	Threshold for charging, rising (N2300)	2.1 V (typ.)
VMSTR-	Threshold for charging, falling (N2300)	1.9 V (typ.)
VCOFF+	Hardware cut off (rising)	2.9 V (typ.)
VCOFF-	Hardware cut off (falling)	2.6 V (typ.)
SWCOFF	Software cut off limit	~3.2 V

The master reset threshold controls the internal reset of EM ASICs. If battery voltage is above VMSTR, N2300 charging control logic is alive. Also, the RTC is active and supplied from the main battery. Above VMSTR, N2300 allows the system to be powered on although this may not succeed due to voltage drops during start up. SW can also consider battery voltage too low for operation and power down the system.

Power key

The system boots up when power key is pressed (adequate battery voltage, VBAT, present).

Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). Power on key is connected to the EM ASIC N2200 via PWRONX signal.

Power distribution

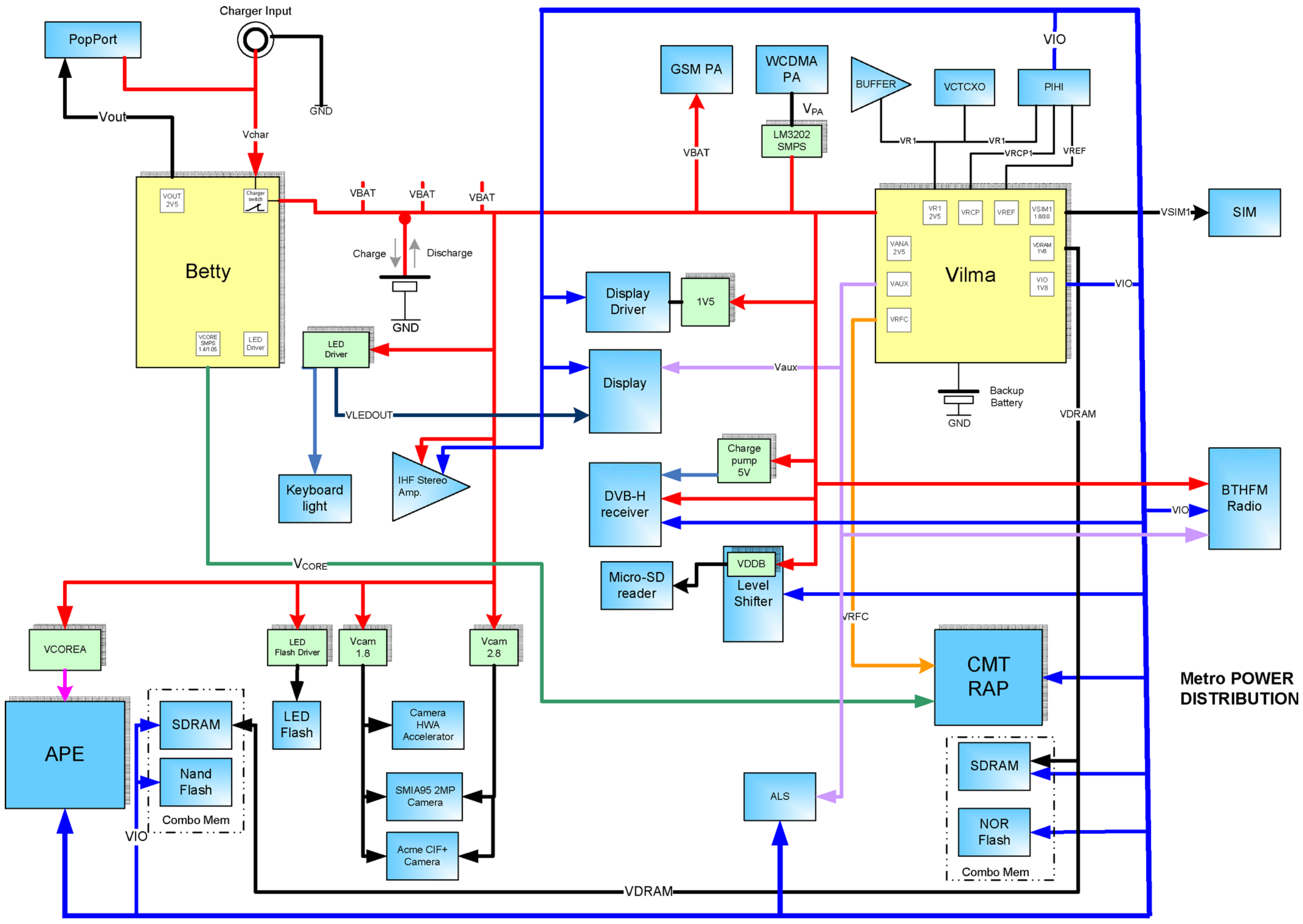
PopPort
Charger Input
GND
Vout
Vchar
Betty
VOUT 2V5
Charger switch
VCORE SMPS 1.4/1.05
LED Driver
VBAT
VBAT
VBAT
Charge
Discharge
GND
LED Driver
VLEDOUT
Keyboard light
IHF Stereo Amp.
VCORE
GSM PA
WCDMA PA
VPA
LM3202 SMPS
VBAT
BUFFER
VCTCXO
PIHI
VIO
VR1
VR1
VRCP1
VREF
Vilma
VR1 2V5
VRCP
VREF
VSIM1 1.8/3.0
VANA 2V5
VAUX
VRFC
VDRAM 1V8
VIO 1V8
VSIM1
SIM
VIO
Display Driver
1V5
Display
Vaux
Charge pump 5V
DVB-H receiver
Backup Battery
GND
VDRAM
BTHFM Radio
VIO
Micro-SD reader
VDDB
Level Shifter
VRFC
CMT RAP
Metro POWER DISTRIBUTION
VCOREA
APE
SDRAM
Nand Flash
Combo Mem
VIO
LED Flash Driver
LED Flash
Vcam 1.8
Vcam 2.8
Camera HWA Accelerator
SMIA95 2MP Camera
Acme CIF+ Camera
ALS
SDRAM
NOR Flash
Combo Mem
VDRAM

Figure 38 RM-194 power distribution

Power supply components

- EM ASIC N2200
- EM ASIC N2300
- Application processor VCORE SMPS, N4200
- Camera and camera accelerator supplies: N5200, N5201
- Mini SD regulator: N4902
- Flash LED driver: N5202
- DVB-H antenna tuning driver: N6800
- LCD controller driver: N4405
- Display and keyboard backlight driver: N2301

All the above are powered by the main battery voltage.

Battery voltage is also used on the RF side for power amplifiers (GSM PA & WCDMA PA) and for RF ASICs.

Discrete power supplies are used to generate 2.8 V and 1.8 V for the cameras and HWA, 1.3 V/1.5 V for the application processor and 18 V for the backlight LEDs, 3.0 v for microSD card and 1.5 V for LCD controller. Charge pump N6800 generates up tp 4.5 V for DVB-H antenna tuning circuitry.

The device supports both 1.8 V/3 V SIM cards which are powered by VSIM1. VSIM2 is used to enable the regulator used to supply 3V for the mini-SD card interface.

USB accessories which need power from the device are powered by N2300 / VOUT.

The internal LED driver in N2300 is used in this engine implementation.

System power-up

After inserting the main battery, regulators started by HW are enabled. SW checks, if there is some reason to keep the power on. If not, the system is set to power off state by watchdog. Power up can be caused by the following reasons:

- Power key is pressed
- Charger is connected
- RTC alarm occurs
- MBUS wake-up

After that:

- N2200 activates sleep clock and VANA, VDRAM, VIO and VR1 regulators.
- Voltage appearing at N2200 RSTX pin is used for enabling N2300 ASIC.
- N2300 enables VCORE regulator and its internal RC-oscillator (600 kHz).
- VCTCXO regulator is set ON and RF clock (main system clock) is started to produce.
- N2200 will release PURX ~ 16 ms after power up is enabled (the RF clock is then stable enough).
- Synchronizing clock (2.4 MHz) for N2300 is started to be produced. After PURX is released and two rising edges of 2.4 MHz synchronous clock have been detected in SMPSClk input N2300 starts to use that instead of the 600 kHz internal RC-oscillator.
- HW start-up procedure has been finalized and the system is up and running. Now it is possible for SW to switch ON other needed regulators.

Clocking scheme

There are two main clocks in the system: 38.4 MHz RF clock produced by VCTCXO in RF section and 32.768 kHz sleep clock produced by the EM ASIC N2200 with an external crystal.

RF clock is generated only when VCTCXO is powered on by the EM ASIC regulator. The regulator itself is activated by SleepX signals from both RAP and application processor. When both CPUs are on sleep, RF clock is stopped.

RF clock is used by RAP, which provides (divided) 19.2 MHz SysClk further to the application processor. Both RAP and the application processor have internal PLLs which then create clock signals for other peripheral devices/interfaces like RS MMC, SIM, CCP, I2C and memories.

32k Sleep Clock is always powered on after startup. Sleep clock is used by RAP and the application processor for low-power operation.

SMPS Clk is 2.4 MHz clock line from RAP to EM ASIC N2300 used for switch mode regulator synchronizing in active mode. In deep sleep mode, when VCTCXO is off, this signal is set to '0'-state.

BT Clk is 38.4 MHz signal from the RF ASIC to the Bluetooth system.

CLK600 is 600 KHz signal from EM ASIC N2300 to APE VCORE SMPS. The clock source is internal RC oscillator in EM ASIC (during the power-up sequence) or RAP SMPS Clk divided by 4 after the power-up sequence.

Bluetooth

The Bluetooth chip is integrated together with FM radio chip into the BTHFM module. Bluetooth provides a fully digital link for communication between a master unit and one or more slave units.

The system provides a radio link that offers a high degree of flexibility to support various applications and product scenarios.

Data and control interface for a low power RF module is provided. Data rate is regulated between the master and the slave.

FM radio

The FM radio is an integrated circuit which is in combined BTHFM module with Bluetooth chip, controlled by MCU software through a serial bus interface. The wires of the headset are used as poles of the antenna, and no other antenna is needed for FM radio reception.

The antenna for the FM radio is provided by plugging in an external wired headset to the system connector. It is not possible to listen to the FM radio without a wired headset connected.

The FM radio is controlled by I2C commands from RAP. The audio output of the FM radio is fed to the headset via AVILMA EM ASIC N2200 and analog switch, so the rest of the phone can sleep while the FM radio is active.

USB

USB (Universal Serial Bus) provides a wired connectivity between a USB host PC and peripheral devices.

USB is a differential serial bus for USB devices. USB controller supports USB specification revision 2.0 with full speed USB (12 Mbps). The device is connected to the USB host through the system connector. The USB bus is hot plugged capable, which means that USB devices may be plugged in/out at any time.

SIM interface

The device has one SIM (Subscriber Identification Module) interface. It is only accessible if battery is removed. The SIM interface consists of an internal interface between RAP and EM ASIC N2200 and of an external interface between N2200 and SIM contacts.

The SIM IF is shown in the following figure:

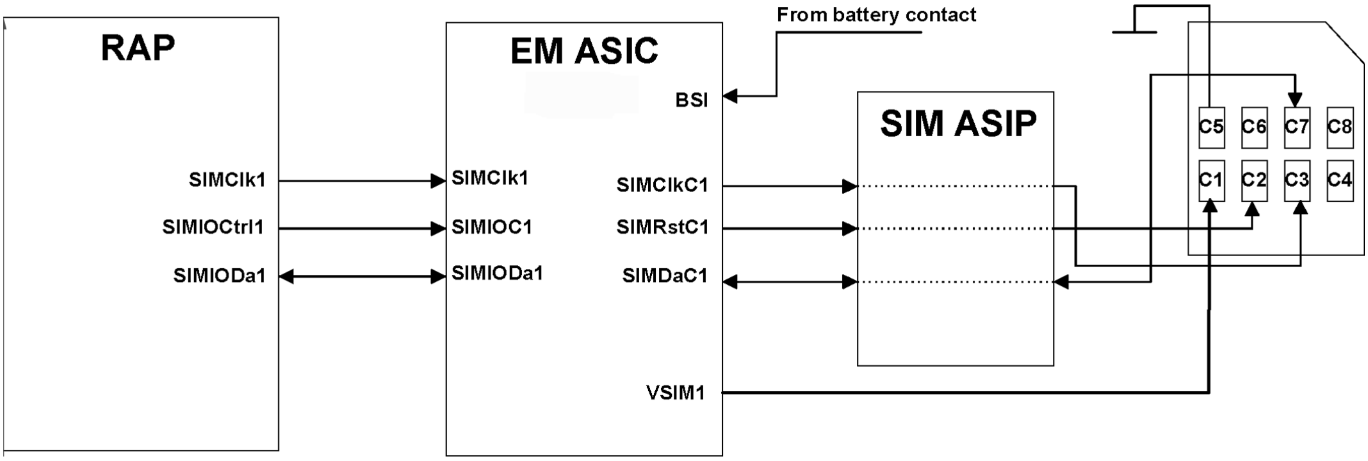

Figure 39 SIM interface

MicroSD card interface

MicroSD card reader is mounted on the main PWB. The MicroSD card is supplied with 3 V supply voltage from a regulator that also has level shifter and EMI filter integrated. MicroSD card reader has two switches.

One is for detecting the card inside the reader and the other, pre-warning switch, is used to detect removal of the card so that the writing to card can be stopped and data corruption is prevented

DVB-H interface

The device has an integrated DVB-H receiver module. Module contains an integrated BB and RF chip, voltage regulator for the chip and filtering components. It is able to receive 6, 7 or 8MHz (channel width depending on used standard in different countries) DVB-H transmissions over 470-750MHz band.

The receiver decapsulates IP packets (e.g. audio and video data) from the stream and forwards them to the application processor.

The module contains all needed DVB-H receiver functions excluding antenna. Antenna is integrated to the C-cover and it also requires an external antenna tuning circuit which is controlled by the module itself.

Battery interface

The battery interface supports a 3-pole battery interface. The interface consists of three connectors: VBAT, BSI and GND.

The BSI line is used to recognize the battery capacity by a battery internal pull down resistor.

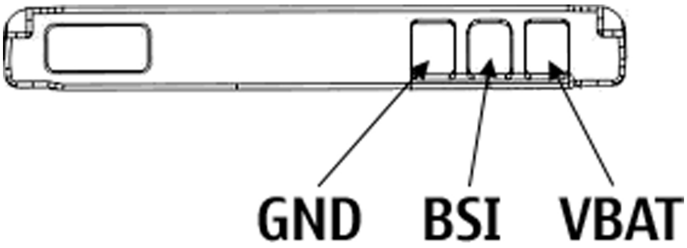

Figure 40 Battery pin order

Table 18 Battery interface connections

Pin	Signal	I/O	Engine connection		Notes
1	VBAT	->	EM ASIC N2200	VBAT	Battery voltage
2	BSI	->	EM ASIC N2200	BSI	Battery size indication (fixed resistor inside the battery pack)
3	GND		GND		Ground

Battery temperature is estimated by measuring separate battery temperature NTC via the BTEMP line, which is located on the transceiver PWB, at a place where the phone temperature is most stable.

For service purposes, the device SW can be forced into local mode by using pull down resistors connected to the BSI line.

Camera interfaces

Main camera interface

The main camera of the device uses a SMIA95 2.0 mega pixel module producing pictures with resolution of up to 1600x1200. Cameras image processing is done in specific camera hardware accelerator. The camera regulator N4441 powers the digital parts of the camera and N4442 powers the analogue parts.

Main camera specifications

This section describes the mechanical construction of the camera module for getting a better understanding of the actual mechanical structure of the module.

Sensor type	CMOS	
Sensor photo detectors (effective)	1600x1200	

F number/Aperture	3.2	
Focus range	70cm -> infinity	
Still image resolutions	1600x1200, 1152x864 and 640x480	
Still images file format	EXIF (.jpg)	
Video resolutions	352x288 and 176x144	
Video clip length	30sec short mode or 1 hour free mode	
Video file format	3GPP, (*.3gp) or MPEG-4 (*.mp4)	
Exposure control	Automatic	
White balance	Automatic	
Colours	16.7Million, 24bit	

Front camera specifications

The front camera has a resolution of CIF+ (382x320) and is used mainly for video calls. It can also be used totake still images and video clips. The front camera control and image processing is done on the same hardware accelerator as the main camera. The front camera has the following characteristics.

Sensor type	CMOS	
Sensor photo detectors (effective)	384x320	
F number/Aperture	2.8	
Focus range	25cm -> 1m	
Still image resolutions	320x240	
Still images file format	EXIF (.jpg)	
Video resolutions	352x288, 176x144 or 128x96	
Video clip length	30sec short mode or 1 hour free mode	
Video file format	3GPP, (*.3gp) or MPEG-4 (*.mp4)	
Exposure control	Automatic	
White balance	Automatic	
Colours	16.7Million, 24bit	

Flash LED

The device main camera has a flash LED located directly beside the camera providing better lighting conditions in darker environment.The flash LED consists of 4 white LEDs in series in one module.

The module has a lens for directing the light to right direction. The flash is controlled with same hardware accelerator that controls both cameras.

The flash module is also used as indicator while shooting video.

In this case the same driver is driven to another mode consuming much less power. The connections between the main PWB and the FLED are implemented with a pair of “pogo” pins.

User interface

User interface

The user interface of the handset consists of a complete keyboard/navi-key module connected to the engine PWB by a flexi circuit and some parts of the engine PWB.

The user interface sections contained on the engine PWB are:

- Main power key (via flex)
- Dedicated camera shutter key
- Volume/zoom keys
- Gallery key

Keyboard

The device keyboard is contained on a separate UI flex. All the keys are part of the same matrix, and the ones on the UI board are connected to the APE ASIC via ASIP.

Table 19 Keymatrix

	Col_0	Col_1	Col_2	Col_3	Col_4
Row_0	Left soft key	Right soft key	Send		
Row_1	Select	Left	up	Down	Right
Row_2	7	2	3	8	Volume up
Row_3	5	TV	1	6	
Row_4	9	*	Operator	#	
Row_5	End	Camera		4	
Row_6	0	Edit	Clear	Apps	Volume down

Main display

Display module mechanical concept

Display features:

- Module size (width x height x thickness) 41.92 mm, 60.55 mm, 2.72 mm
- Resolution QVGA
- Numbers of colours up to 16.7 Million, 24-bit
- Partial display function; power saving by pausing display process on part of the screen.
- Built-in RAM capacity 240 columns x 320 rows x 18 bits = 1,382,400 bits

The display has two different operating modes:

- Normal mode, Full screen, 16.7M colors
- Partial idle mode, 8 colours but only part of the display is active

The interconnection between the LCD module and the Nokia engine is implemented with a 24-pin board-to-board connector.

The display is controlled via a MeSSi-16 interface with an 8-bit bus by the application processor. All MeSSi-16 signals go through the EMC filtering ASIPs. The display module does not require any tunings in service.

Display and keyboard backlight

The device uses an external LED driver to drive the LEDs in both the keyboards and the display. The chain of LEDs on the UI board consists of four LEDs and the display has a series of three LEDs.

Current feedback is done through the display LEDs only, with the chains being driven from the display LED voltage through an emitter follower, controlled by BETTY_GenOut 1.

ALS interface

The device uses a logarithmic ambient light sensor to control display and keyboard backlights. Current values from light sensors are converted to voltages and are read into Vilma (N2200) through ADC block. Betty (N2300) controls the switch and turns the ALS on when ambient light levels are read. In the dark conditions display backlights are dimmed and keyboard LEDs are turned on and in brighter ambient lighting the keyboard LEDs are turned off and display backlight is made more brighter.

ASICs

RAP ASIC

RAP ASIC is a 3G Radio Application Processor. RAM memory is integrated into RAP.

EM ASIC N2200

The EM ASIC (N2200) includes the following functional blocks:

- Start up logic and reset control
- Charger detection
- Battery voltage monitoring
- 32.768kHz clock with external crystal
- Real time clock with external backup battery
- SIM card interface
- Stereo audio codecs and amplifiers
- A/D converter
- Regulators
- Vibra interface
- Digital interface (CBUS)

EM ASIC N2300

The EM ASIC (N2300) includes the following functional blocks:

- Core supply generation
- Charge control circuitry
- Level shifter and regulator for USB/FBUS
- Current gauge for battery current measuring
- LED driver for backlights
- Digital interface (CBUS)

Device memories

RAP memories NOR flash and SDRAM

Modem memory consists of 128 Mbit SDRAM and 128 Mbit NOR flash memories.

Combo memory

The application memory of the device consists of NAND/DDR combo memory. The stacked DDR/NAND application memory has 512 Mbit of DDR memory and 1024 Mbit of flash memory.

■ Audio concept

Audio HW architecture

The functional core of the audio hardware is built around two ASICs: RAP CMT engine ASIC and the mixed-signal EM ASIC N2200.

There are four audio transducers:

- Dynamic earpiece
- 2 dynamic speakers
- Electret microphone module

In addition to the audio transducers, N2200 also provides an output for the dynamic vibra component.

All galvanic audio accessories are connected to the system connector accessory connector.

A Bluetooth audio module that is connected to RAP supports Bluetooth audio functionality.

There is a separate application processor for Symbian applications.

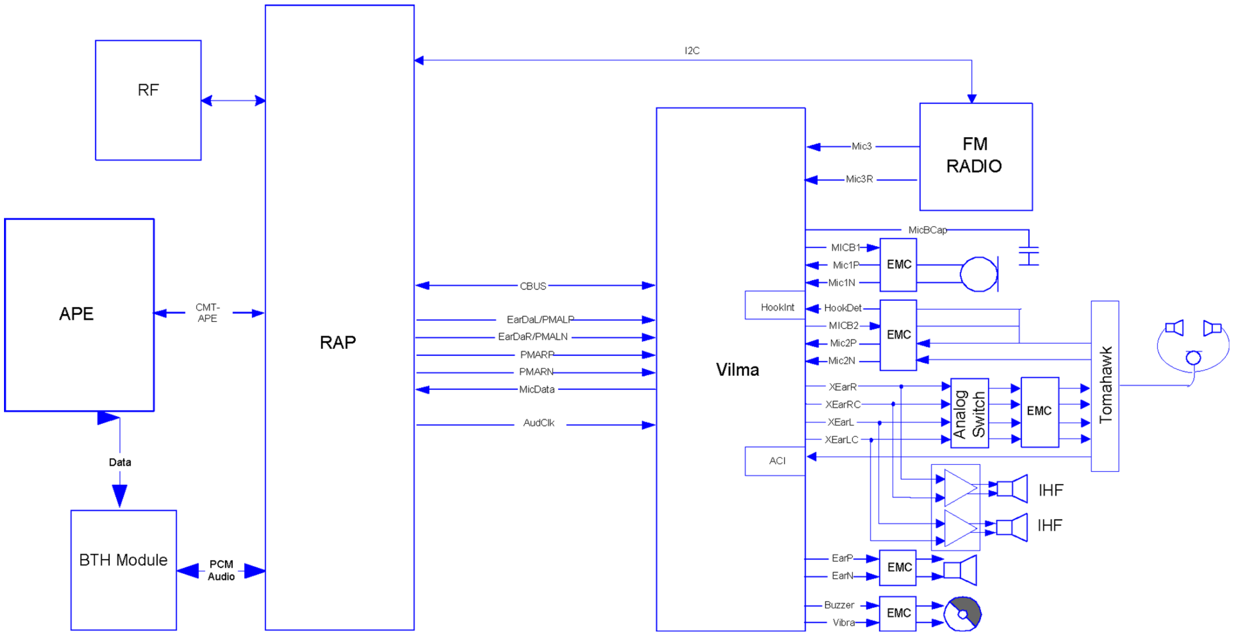
RF
RAP
I2C
APE
CMT-APE
Data
BTH Module
PCM Audio
CBUS
EarDaL/PMALP
EarDaR/PMALN
PMARP
PMARN
MicData
AudClk
Vilma
HookInt
ACI
FM RADIO
Mic3
Mic3R
MicBCap
MICB1
Mic1P
Mic1N
EMC
HookDet
MICB2
Mic2P
Mic2N
XEarR
XEarRC
XEarL
XEarLC
Analog Switch
Tomahawk
IHF
IHF
EarP
EarN
Buzzer
Vibra

Figure 41 Audio block diagram

Internal microphone

The internal microphone is used for HandPortable (HP) and Internal HandsFree (IHF) call modes.

An analogue electret microphone is connected to the EM ASIC (N2200) Mic1P and Mic1N inputs via asymmetric electrical connection.

The microphone is biased by the EM ASIC MicB1 bias voltage output.

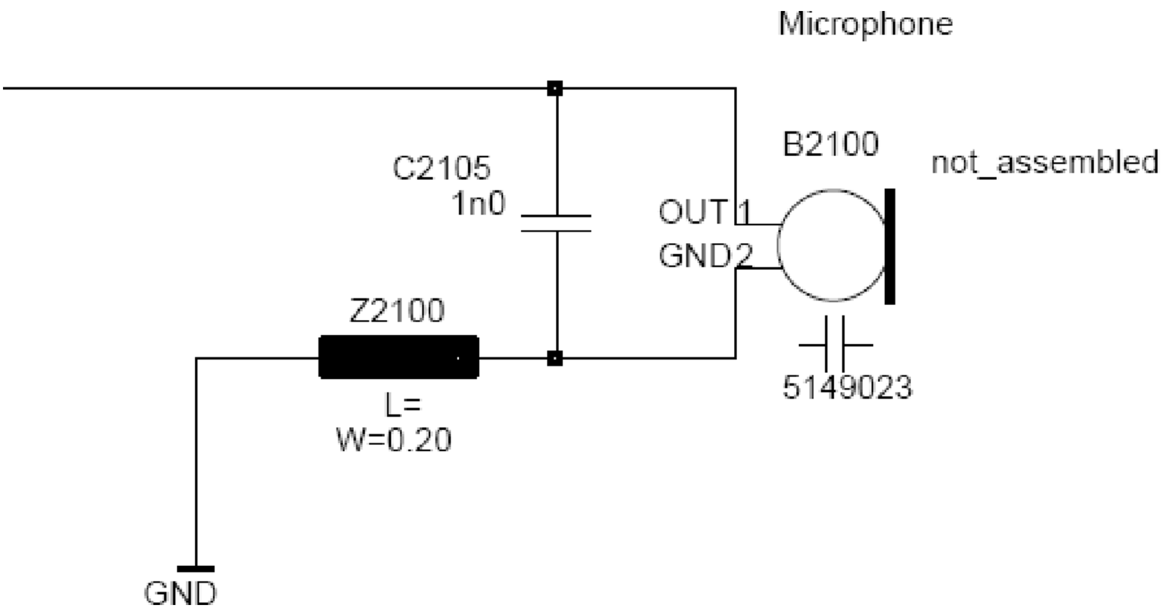

Figure 42 Internal microphone

External microphone

Galvanic accessories are connected to the system connector. Accessory audio mode is automatically enabled/ disabled during connection/disconnection of dedicated phone accessories. The external microphone is used for headset call modes.

An analogue electret microphone is connected to the EM ASIC (N2200) Mic2P and Mic2N inputs via asymmetric electrical connection. The microphone is biased by the EM ASIC MicB2 bias voltage output.

A dynamic earpiece capsule is connected to the EM ASIC (N2200) differential outputs EarP and EarN. N2200 outputs are switched between Internal speaker and external earpiece using switch component N2100. N2200 provides two output channels in either single-ended or differential format.

N2200 outputs XearL and XearLC for the left channel audio output, and XearR and XearRC the right channel audio output.

XearLC and XearRC are the ground pins if using single-ended mode. On the system connector side, HSEAR_P and HSEAR_N form the left channel output, and HSEAR_R_P and HSEAR_R_N form the right channel output. HSEAR_N and HSEAR_R_N are the ground pins in single-ended mode.

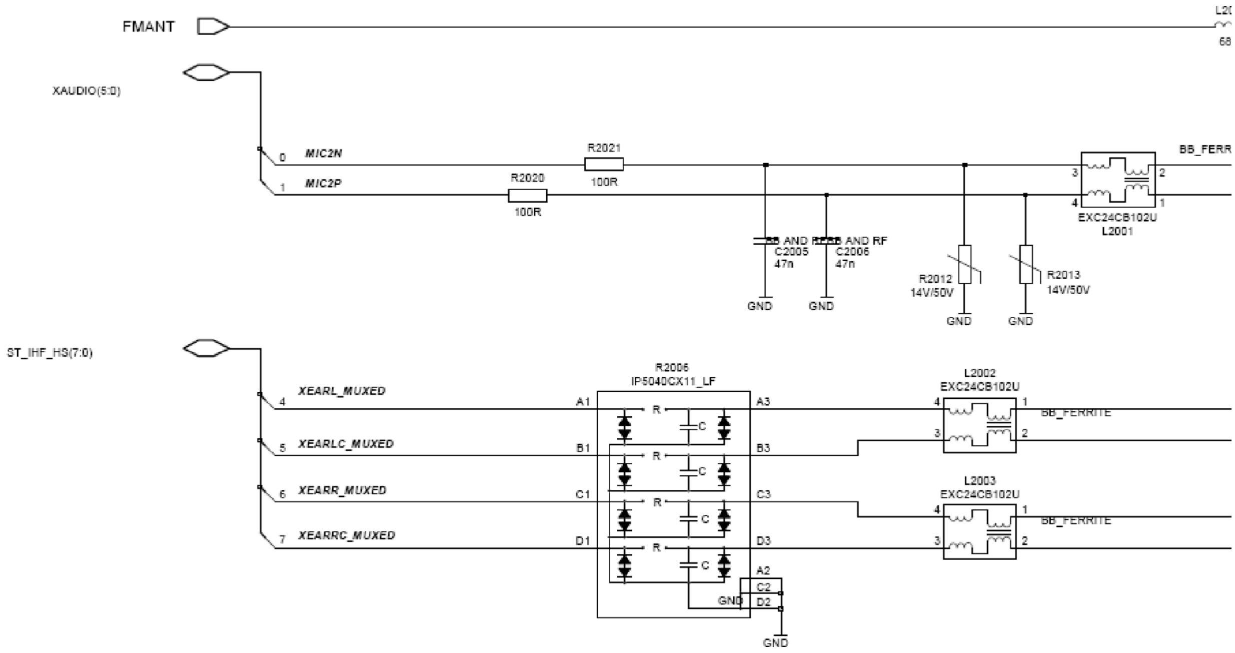
FMANT
XAUDIO(5:0)
0
MIC2N
1
MIC2P
R2021
100R
R2020
100R
C2005
47n
C2006
47n
AND RF
GND
GND
R2012
14V/50V
R2013
14V/50V
GND
GND
EXC24CB102U
L2001
BB_FERR
68
ST_IHF_HS(7:0)
4
XEARL_MUXED
5
XEARLC_MUXED
6
XEARR_MUXED
7
XEARRC_MUXED
R2006
IP5040CX11_LF
A1
B1
C1
D1
A3
B3
C3
D3
A2
C2
D2
R
C
GND
GND
L2002
EXC24CB102U
L2003
EXC24CB102U
BB_FERRITE
BB_FERRITE

Figure 43 External microphone and earpiece circuitry (system connector connects to the right side)

Internal earpiece

The internal earpiece is used in the HandPortable (HP) call mode. A dynamic earpiece capsule is connected directly to the EM ASIC (N2200) differential outputs EarP and EarN.

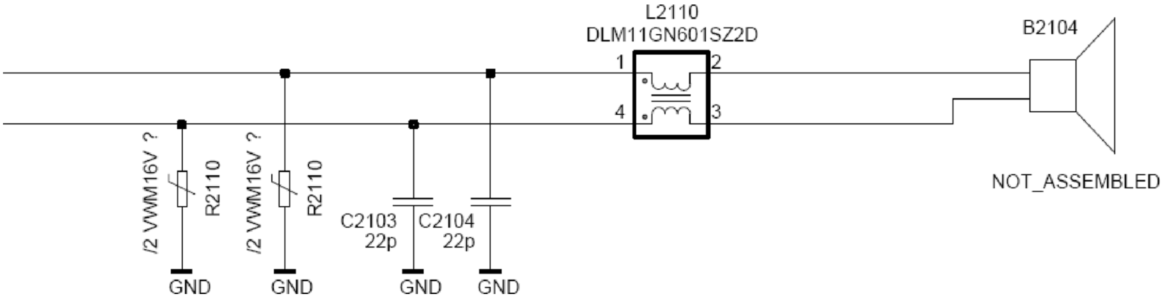
L2110
DLM11GN601SZ2D
1
2
4
3
B2104
NOT_ASSEMBLED
/2 VWM16V ?
R2110
/2 VWM16V ?
R2110
C2103
22p
C2104
22p
GND
GND
GND
GND

Figure 44 Internal earpiece

Internal speaker

The internal speakers are used in Internal HandsFree (IHF) call mode.

N2200 outputs are switched between Internal speakers and external earpiece using switch component N2100. Two dynamic speakers are connected to the N2101 dual amplifier.

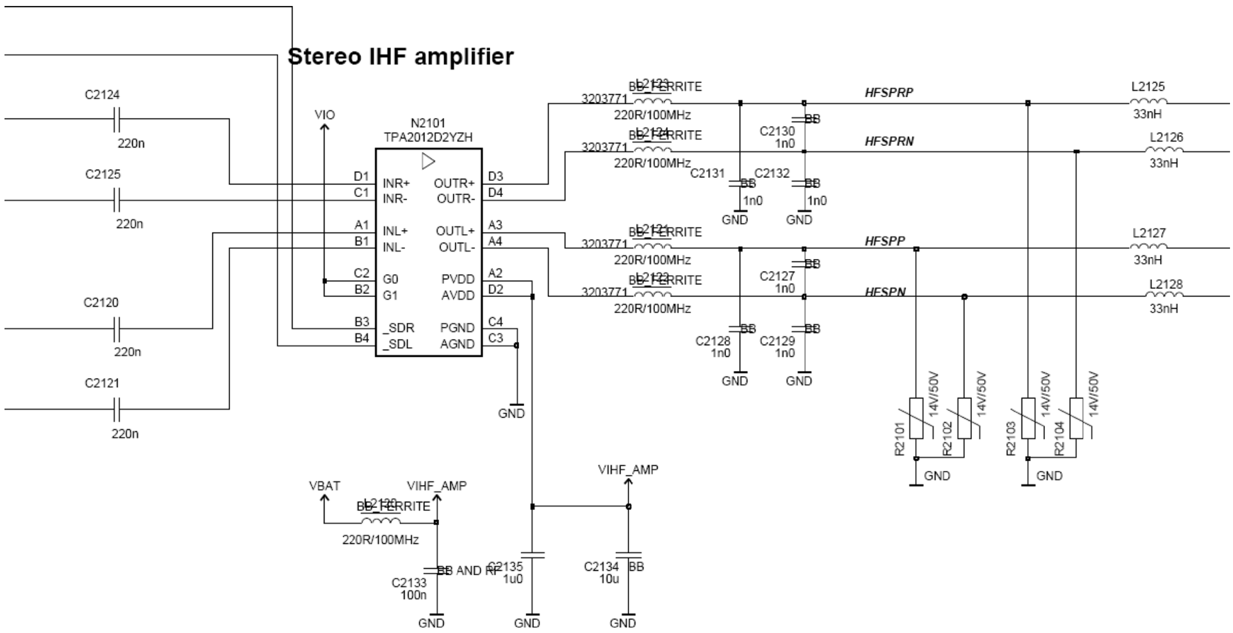
Stereo IHF amplifier
C2124
220n
C2125
220n
C2120
220n
C2121
220n
VIO
N2101
TPA2012D2YZH
D1
C1
A1
B1
C2
B2
B3
B4
INR+
INR-
INL+
INL-
G0
G1
_SDR
_SDL
OUTR+
OUTR-
OUTL+
OUTL-
PVDD
AVDD
PGND
AGND
D3
D4
A3
A4
A2
D2
C4
C3
GND
3203771
BB_FERRITE
L2123
220R/100MHz
L2124
L2121
L2122
C2130
1n0
C2131
C2132
BB
1n0
C2127
1n0
C2128
1n0
C2129
1n0
GND
HFSPRP
HFSPRN
HFSPP
HFSPN
L2125
33nH
L2126
33nH
L2127
33nH
L2128
33nH
R2101
R2102
R2103
R2104
14V/50V
VBAT
VIHF_AMP
L2120
220R/100MHz
C2133
100n
BB AND RF
C2135
1u0
C2134
10u

Figure 45 Internal speaker circuitry

Vibra circuitry

Vibra is used for vibra-alarm function.

The vibra motor is connected to the EM ASIC (N2200) VibraP and VibraN Pulse Width Modulated (PWM) outputs. The vibra is connected to N2200 using connector X2100.

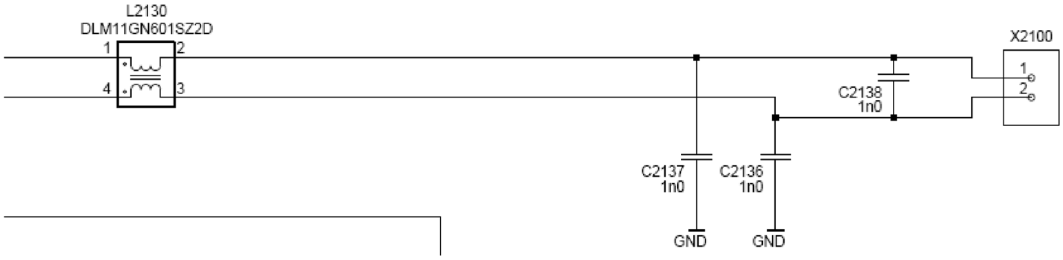
L2130
DLM11GN601SZ2D
1
2
4
3
X2100
1
2
C2138
1n0
C2137
1n0
C2136
1n0
GND
GND

Figure 46 Vibra circuitry

System connector

The system connector provides a fully differential 4–wire stereo line-level output connection and a fully differential 2-wire mono line-level or microphone level input connection.

The handsfree driver in one of the EM ASICs is meant for the headset.

The output is driven in a fully differential mode. In the fully differential mode, the handsfree pin is the negative output and the HFCM pin is the positive output. The gain of the handsfree driver in the differential mode is 6 dB.

The earpiece and headset signals are multiplexed so that the outputs cannot be used simultaneously.

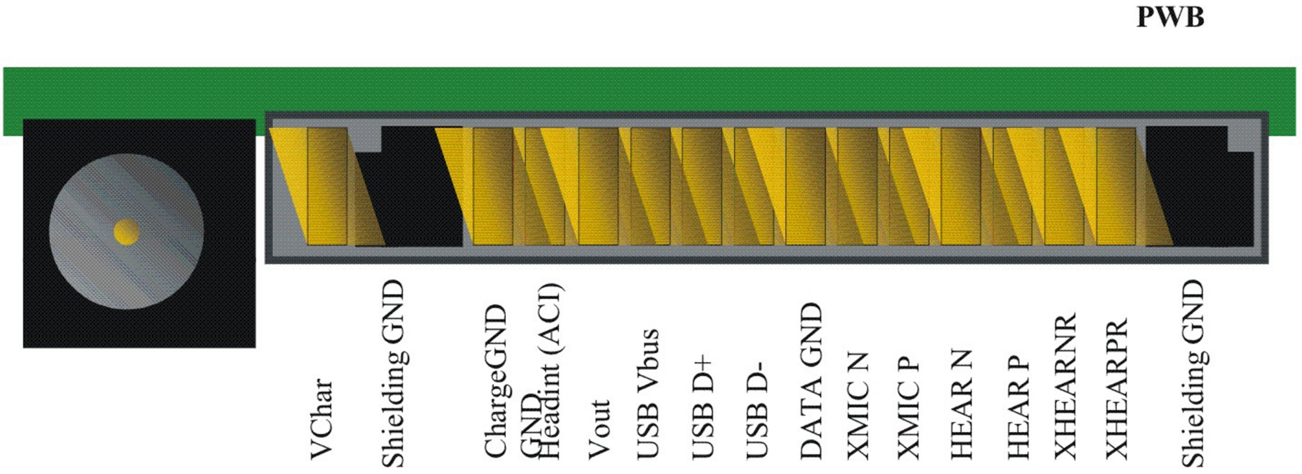
PWB
VChar
Shielding GND
ChargeGND
GND
Headint (ACI)
Vout
USB Vbus
USB D+
USB D-
DATA GND
XMIC N
XMIC P
HEAR N
HEAR P
XHEARNR
XHEARPR
Shielding GND

Figure 47 External audio connector

Table 20 Audio connector pin assignments

Pin #/ Signal name	Signal description	Spectral range	Voltage/ Current levels	Max or nominal serial impedance	Notes
1/ Charge	V Charge	DC	0-9V/ 0.85A		
2/ GND	Charge GND	-	0.85A	100mΩ (PWB+ conn.)	
3/ ACI	ACI	1kbits/s	Digital 0 / 2.5-2.78V	47Ω	Insertion & removal detection
4/ Vout	DC out	DC	2.78V 70 mA 2.5V 90mA	100mΩ (PWB+ conn.)	200mW
9 / XMIC N	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
10 / XMIC P	Audio in	300-8k	1Vpp & 2.5-2.78VDC		
11 / HEAR N	Audio out	20-20k	1Vpp	10Ω	
12 / HEAR P	Audio out	20-20k	1Vpp	10Ω	
13 / HEAR R N	Audio out	20-20k	1Vpp	10Ω	Not conn. in mono
14 / HEAR R P	Audio out	20-20k	1Vpp	10Ω	Not conn. in mono

Baseband technical specifications

External interfaces

External interfaces

Name of Connection	Connector reference
USB	X2001
Charger	X2000
Headset	X2001
SIM	X2700
MicroSD	X4900
Battery connector	X2070

VOUT electrical characteristics

Description	Parameter	Min	Max	Typical	Unit	Notes
Vout regulator for external accessories	VOUT	2.43	2.57	2.5	V	Max load 90mA

SIM IF connections

Pin	Signal	I/O	Engine connection		Notes
C1	VSIM	Out	EM ASIC N2200	VSIM1	Supply voltage to SIM card, 1.8V or 3.0V.
C2	SIMRST	Out	EM ASIC N2200	SIM1Rst	Reset signal to SIM card
C3	SIMCLK	Out	EM ASIC N2200	SIM1ClkC	Clock signal to SIM card
C5	GND	-	GND		Ground
C7	SIMDATA	In/Out	EM ASIC N2200	SIM1DaC	Data input / output
SW	SIM_DET	In	EM ASIC N2200	SIMDetX	Removal detection

Charger connector and charging interface connections & electrical characteristics

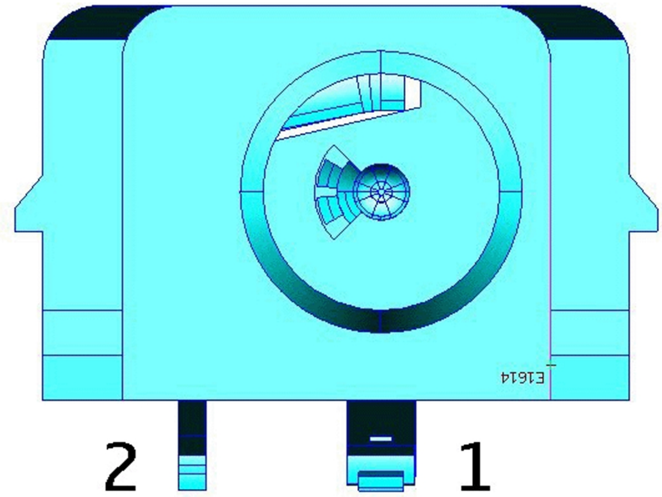

Figure 48 Charger connector

Table 21 Charging interface connections

Pin	Signal	I/O	Engine connection		Notes
1	Vchar	In	N2300	VCharIn1, 2	Charging voltage / charger detection, Center pin
2	Charge GND		Ground		Charger ground

Table 22 Charging IF electrical characteristics

Description	Parameter	Min	Max	Unit	Notes
Vchar	V Charge	0	9	V	Center pin
Vchar	I Charge		0.85	A	Center pin
Charge GND			0.85	A	

Internal interfaces

Internal interfaces

Name of connection	Connector reference
UI connector	X4400
Main camera	X5201
Flash connector	X5200
Power key	X4410, X4411

Name of connection	Connector reference
Display connector	X4401

UI module connector and IF connections

Keyboard interface electrical characteristics

Description	Parameter	Min	Typ	Max	Unit	Notes
High-level input voltage	V_{IH}	0.65* V_{DDS}	V_{DDS}	0.3+ V_{DDS}	V	Row
Low-level input voltage	V_{IL}	-0.3	0	0.35* V_{DDS}	V	Row
High-level output voltage	V_{OH}	1.62	V_{DDS}	1.98	V	Column
Low-level output voltage	V_{OL}		0	0.45	V	Column
(VDDS = 1.8V)						

Keyboard connector and interface connections

Pin	Signal	I/O	Engine connections
1	GND		
2	VLED	N2301/N2300	
3	GND		
4	Row_0		APE
5	GND		
6	Row_1		APE
7	GND		
8	GND		
9	GND		
10	ROW_2		APE
11	ROW_3		APE
12	ROW_4		APE
13	ROW_5		APE
14	ROW_6		APE
15	GND		
16	VLEDOUT	Betty I/O controlled GND	

Pin	Signal	I/O	Engine connections
17	GND		
18	COL_0		APE
19	COL_1		APE
20	COL_2		APE
21	COL_3		APE
22	COL_4		APE
23	GND		
24	GND		

Back-up battery interface electrical characteristics

Table 23 Back-up battery connections

Pin name	I/O	Connection	Notes
G2200, VBack	->	N2200, VBack	Back-up battery is connected straight to N2200.

RF description

RF introduction

The RF is controlled by digital baseband circuitry via a serial bus (RFBus). The RFBus is for mode selection, frequency synthesizer control, RX AGC setting, RF regulator control, TX power control loop and PA bias control. In addition to RFBus there are also several other interface signals coming from BB. TX power control (TXC), VCTCXO frequency control (AFC) and some other control signals (voltage and current references, WCDMA TX power detection, PA combination detection).

Regulators

All RF regulators, except one, are located in the EM ASIC N2200 in the baseband section or in the RF ASIC of the device. The discreet regulator, N7541, feeds the WCDMA PA. The EM ASIC N2200 has three regulators for RF:

- 2.5 V regulator VXO
- 4.75 V regulator VCP (VCP1 & VCP2)
- 1.35 V regulator, VB_EXT, which is the reference voltage.

RF block diagrams

The RF block diagram for RM-194 uses RF ASIC N7500 as illustrated by the red border in the block diagram.

The RF block diagram for RM-195 is the same as for RM-194 except all WCDMA specific components have been removed.

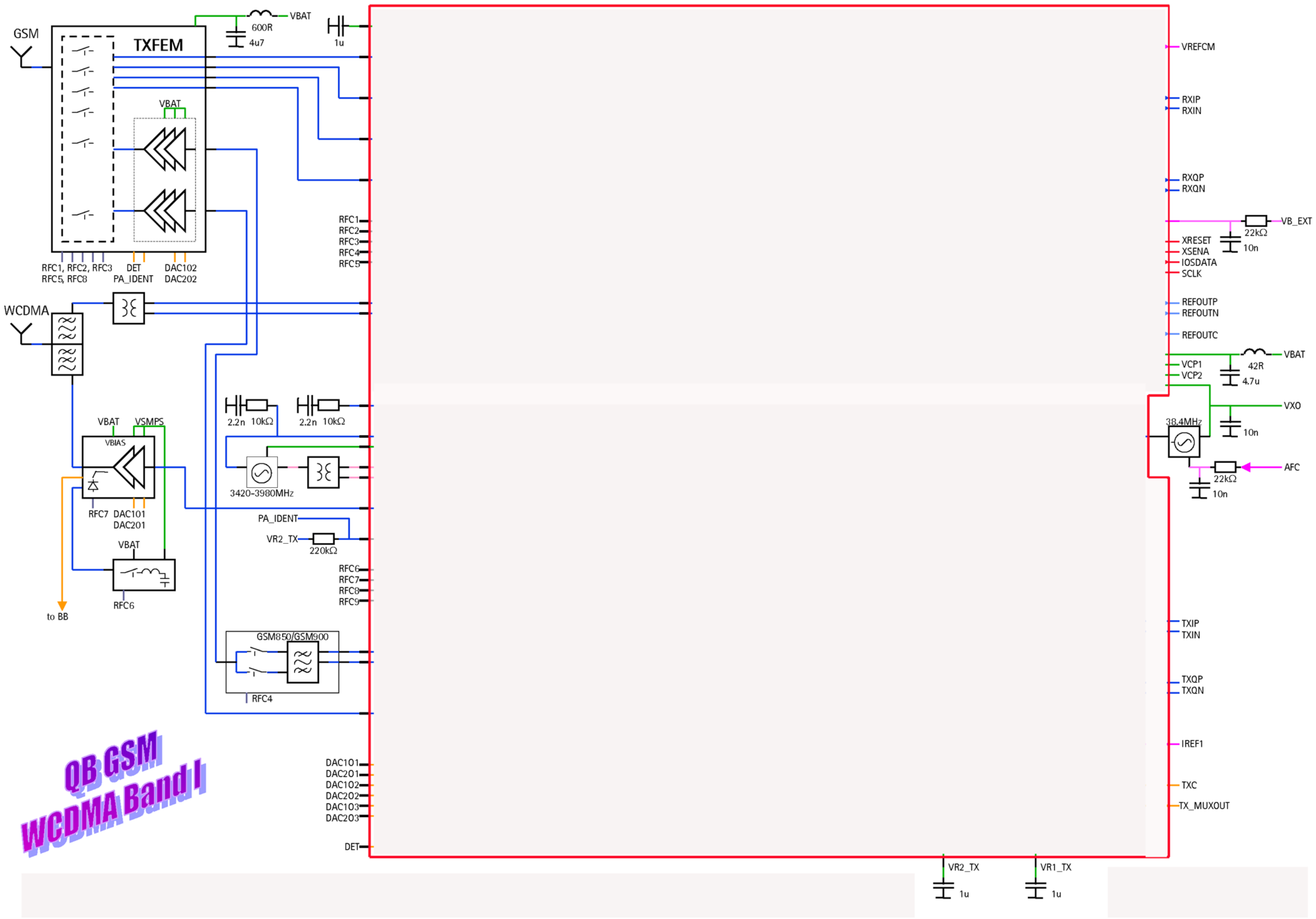
GSM
TXFEM
VBAT
600R
4u7
1u
VBAT
RFC1, RFC2, RFC3
RFC5, RFC8
DET
PA_IDENT
DAC102
DAC202
RFC1
RFC2
RFC3
RFC4
RFC5
WCDMA
2.2n
10kΩ
2.2n
10kΩ
VBAT
VSMPS
VBIAS
RFC7
DAC101
DAC201
3420-3980MHz
PA_IDENT
VR2_TX
220kΩ
VBAT
RFC6
to BB
RFC6
RFC7
RFC8
RFC9
GSM850/GSM900
RFC4
QB GSM
WCDMA Band I
DAC101
DAC201
DAC102
DAC202
DAC103
DAC203
DET
VR2_TX
1u
VR1_TX
1u
VREFCM
RXIP
RXIN
RXQP
RXQN
22kΩ
VB_EXT
10n
XRESET
XSENA
IOSDATA
SCLK
REFOUTP
REFOUTN
REFOUTC
VBAT
42R
4.7u
VCP1
VCP2
VXO
38.4MHz
10n
22kΩ
AFC
10n
TXIP
TXIN
TXQP
TXQN
IREF1
TXC
TX_MUXOUT

Figure 49 RM-194 rf block diagram

Frequency plan

Both, the receiver and the transmitter, are based on direct conversion architecture. The VCOs operate at the channel frequency multiplied by two or four depending on the band of operation. This means that the modulated baseband signals are directly converted up to the transmission frequency and the received RF signals directly down to the baseband frequency.

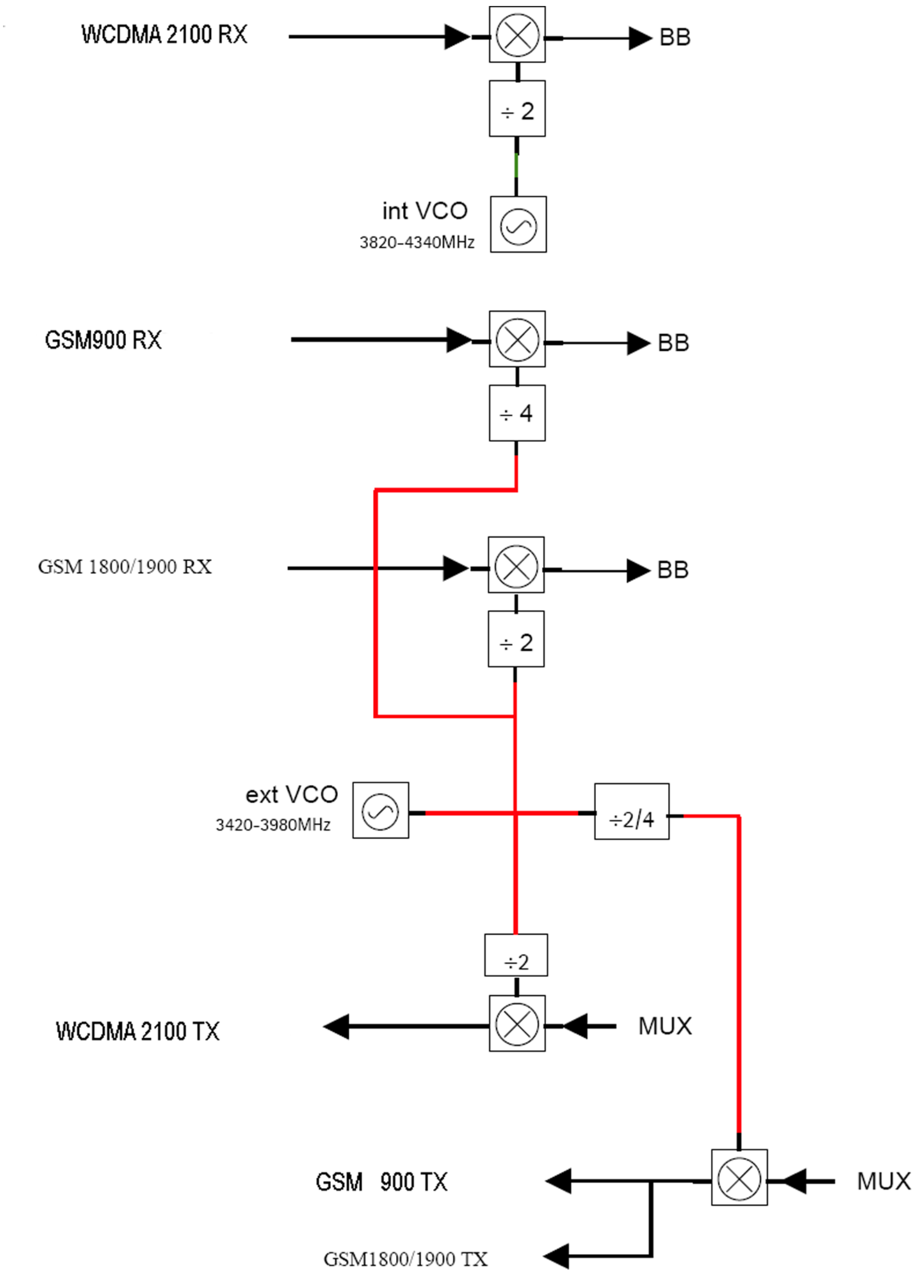
WCDMA 2100 RX
BB
÷ 2
int VCO
3820-4340MHz
GSM900 RX
BB
÷ 4
GSM 1800/1900 RX
BB
÷ 2
ext VCO
3420-3980MHz
÷2/4
÷2
WCDMA 2100 TX
MUX
GSM 900 TX
MUX
GSM1800/1900 TX

Figure 50 RF frequency plan

Receiver

Introduction to receiver functionality

The receiver is a linear direct conversion receiver containing LNA, band pass filter and demodulator for each supported system and band. After the demodulators the signal paths are combined to one common BB path.

WCDMA receiver

There is no single feed switch in the device. WCDMA signal is routed from WCDMA antenna to SAW duplex filter. From the duplex filter, the signal goes through a balun to the integrated LNA in the RF ASIC. From the LNA, the signal goes through a band pass filter. After filtering, the signal goes to the down conversion mixer, which converts the signal into baseband I and Q signals.

At BB frequency the signal is amplified and fed to a low pass filters.

The filter is followed by an AGC amplifier with adjustable gain. The signal is further amplified before it is fed to balanced analog IQ output pins. Analogue output pins are accompanied by reference voltage output, which sets the DC level for the AD converter in BB ASIC.

GSM receiver

As GSM Rx branches are functionally identical, the following description is applicable to all of them.

The received signal goes from the GSM antenna to the single feed switch, which routes the received GSM signal to a front-end module, containing a PIN diode switch matrix. The switch matrix is used for the GSM band as well as for the Rx/Tx selection.

The switch matrix is followed by integrated LNA stages in the RF ASIC. The LNAs are followed by demodulators which down-convert the signal to baseband I and Q signals.

In the BB-chain there are two adjustable gain stages and one mode specific gain. The first one called BB-gain is just after the demodulator. It has a 12 dB gain range with 6dB steps. After the BB-gain there is the channel select filter.

The main AGC amplifier precedes the channel selection filter. It has 30 dB of gain control range with 3 dB steps. The final amplifier stage is used as an output buffer for IQ signals. This stage is set to 0 dB gain in the GSM mode.

Transmitter

Introduction to transmitter functionality

Transmitter functions are implemented in the RF ASIC N7500.

The RF ASICs contain a BB frequency low pass filter, which is tuneable according the signal bandwidth of the system in use. In addition, they both contain three separate RF paths (GSM900, GSM1800/1900 and WCDMA) comprising of a final frequency IQ modulator and VGA amplifiers.

WCDMA transmitter

In the transmitter side, an analogue I/Q modulated signal is fed from the digital baseband into the RF ASIC and through the low pass filter. After the filter the signal is fed to the I/Q modulator, which converts the signal to final TX frequency. There are two separate I/Q modulators, one for WCDMA and another for EGSM900 and GSM1800/1900 signals. The WCDMA branch is selected by biasing the appropriate modulator. The modulator is followed by two VGA stages. The signal then exits the RF ASIC via a balanced line. The signal is band pass filtered by a SAW filter before it is fed to WCDMA PA module.

There is no single feed antenna switch in the device. TX signal is routed from duplex filter to WCDMA antenna.

WCDMA power control

WCDMA TX power control is performed by the two VGA stages in the RF ASIC.

The gain of VGA amplifier chain is controlled by a DA converter in BB. The same DA converter is shared by GSM TX power control function.

WCDMA PA module

WCDMA PA is housed in a separate module having a variable supply voltage input for the amplifier stages (Vcc11), a battery supply voltage for the bias circuits (Vcc12) and one bias current input. Bias current is generated by 5 bit DA (DAC201) converter in RF ASIC N7500. The converter is controlled via RFBus.

In production the PA quiescent current can be tuned to target value by adjusting the bias current of PA output stage. The bias current is also used as PA on/off controls.

PA DCDC converter

The DCDC converter is controlled by 5 bit DA (DAC101) converter in RF ASIC N7500. The converter is controlled via RFBus. The DCDC converter limits the lowest supply voltage to 1.3 V. At the highest power levels, the DCDC converter output settles nominally to 3.1 V.

GSM transmitter

An analogue IQ modulated signal is fed to the RF ASIC from Digital BB. It is first low pass filtered then routed to the GSM modulator. The appropriate routing after the modulator is selected by biasing either EGSM900 or GSM1800/1900 variable gain amplifier.

After the VGA stage, the signal exits the RF ASIC. In case of GSM1800/1900, the signal goes directly to the GSM PA module. In case of EGSM900, the PA module is preceded by a switchable SAW filter. After the filter, the signal is fed to GSM TX front-end module (TXFEM), which also contains the switch matrix. It routes the output GSM signal to the single feed antenna switch and then to the antenna.

GSM PA module

The TXFEM module contains two separate amplifier chains, one for EGSM900 and another for GSM1800/1900. Both amplifiers have a battery supply connection and two bias current inputs.

Frequency synthesizers

There are two separate synthesizers for WCDMA Rx and WCDMA Tx / GSM Tx / Rx. This allows the duplex separation to be set according the network settings in the WCDMA mode.

The VCOs are locked by PLLs into a reference oscillator, VCTCXO (Voltage Controlled Temperature Compensated Crystal Oscillator).

The PLLs are located in RF ASICs and controlled via RFBus.

Reference oscillator

A 38.4MHz VCTCXO is used as a reference oscillator for the frequency synthesizers.

The frequency of the reference oscillator is locked into the frequency of the base station with the help of an AFC voltage, which is generated in BB by DSP and converted by dedicated DAC.

Frequency mappings

EGSM900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3714,4	18	893,6	938,6	3574,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3715,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3716,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3717,6	22	894,4	939,4	3577,6	3757,6	84	906,8	951,8	3627,2	3807,2
997	884,6	929,6	3538,4	3718,4	23	894,6	939,6	3578,4	3758,4	85	907,0	952,0	3628,0	3808,0
998	884,8	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	86	907,2	952,2	3628,8	3808,8
999	885,0	930,0	3540,0	3720,0	25	895,0	940,0	3580,0	3760,0	87	907,4	952,4	3629,6	3809,6
1000	885,2	930,2	3540,8	3720,8	26	895,2	940,2	3580,8	3760,8	88	907,6	952,6	3630,4	3810,4
1001	885,4	930,4	3541,6	3721,6	27	895,4	940,4	3581,6	3761,6	89	907,8	952,8	3631,2	3811,2
1002	885,6	930,6	3542,4	3722,4	28	895,6	940,6	3582,4	3762,4	90	908,0	953,0	3632,0	3812,0
1003	885,8	930,8	3543,2	3723,2	29	895,8	940,8	3583,2	3763,2	91	908,2	953,2	3632,8	3812,8
1004	886,0	931,0	3544,0	3724,0	30	896,0	941,0	3584,0	3764,0	92	908,4	953,4	3633,6	3813,6
1005	886,2	931,2	3544,8	3724,8	31	896,2	941,2	3584,8	3764,8	93	908,6	953,6	3634,4	3814,4
1006	886,4	931,4	3545,6	3725,6	32	896,4	941,4	3585,6	3765,6	94	908,8	953,8	3635,2	3815,2
1007	886,6	931,6	3546,4	3726,4	33	896,6	941,6	3586,4	3766,4	95	909,0	954,0	3636,0	3816,0
1008	886,8	931,8	3547,2	3727,2	34	896,8	941,8	3587,2	3767,2	96	909,2	954,2	3636,8	3816,8
1009	887,0	932,0	3548,0	3728,0	35	897,0	942,0	3588,0	3768,0	97	909,4	954,4	3637,6	3817,6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3600,8	3780,8	113	912,6	957,6	3650,4	3830,4
					52	900,4	945,4	3601,6	3781,6	114	912,8	957,8	3651,2	3831,2
					53	900,6	945,6	3602,4	3782,4	115	913,0	958,0	3652,0	3832,0
					54	900,8	945,8	3603,2	3783,2	116	913,2	958,2	3652,8	3832,8
					55	901,0	946,0	3604,0	3784,0	117	913,4	958,4	3653,6	3833,6
					56	901,2	946,2	3604,8	3784,8	118	913,6	958,6	3654,4	3834,4
					57	901,4	946,4	3605,6	3785,6	119	913,8	958,8	3655,2	3835,2
					58	901,6	946,6	3606,4	3786,4	120	914,0	959,0	3656,0	3836,0
					59	901,8	946,8	3607,2	3787,2	121	914,2	959,2	3656,8	3836,8
					60	902,0	947,0	3608,0	3788,0	122	914,4	959,4	3657,6	3837,6
					61	902,2	947,2	3608,8	3788,8	123	914,6	959,6	3658,4	3838,4
					62	902,4	947,4	3609,6	3789,6	124	914,8	959,8	3659,2	3839,2

GSM1800 frequencies

Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	793	1766.4	1861.4	3532.8	3722.8
513	1710.4	1805.4	3420.8	3610.8	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	794	1766.6	1861.6	3533.2	3723.2
514	1710.6	1805.6	3421.2	3611.2	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	795	1766.8	1861.8	3533.6	3723.6
515	1710.8	1805.8	3421.6	3611.6	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	796	1767.0	1862.0	3534.0	3724.0
516	1711.0	1806.0	3422.0	3612.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	797	1767.2	1862.2	3534.4	3724.4
517	1711.2	1806.2	3422.4	3612.4	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	798	1767.4	1862.4	3534.8	3724.8
518	1711.4	1806.4	3422.8	3612.8	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	799	1767.6	1862.6	3535.2	3725.2
519	1711.6	1806.6	3423.2	3613.2	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	800	1767.8	1862.8	3535.6	3725.6
520	1711.8	1806.8	3423.6	3613.6	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	801	1768.0	1863.0	3536.0	3726.0
521	1712.0	1807.0	3424.0	3614.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	802	1768.2	1863.2	3536.4	3726.4
522	1712.2	1807.2	3424.4	3614.4	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	803	1768.4	1863.4	3536.8	3726.8
523	1712.4	1807.4	3424.8	3614.8	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	804	1768.6	1863.6	3537.2	3727.2
524	1712.6	1807.6	3425.2	3615.2	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	805	1768.8	1863.8	3537.6	3727.6
525	1712.8	1807.8	3425.6	3615.6	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	806	1769.0	1864.0	3538.0	3728.0
526	1713.0	1808.0	3426.0	3616.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	807	1769.2	1864.2	3538.4	3728.4
527	1713.2	1808.2	3426.4	3616.4	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	808	1769.4	1864.4	3538.8	3728.8
528	1713.4	1808.4	3426.8	3616.8	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	809	1769.6	1864.6	3539.2	3729.2
529	1713.6	1808.6	3427.2	3617.2	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	810	1769.8	1864.8	3539.6	3729.6
530	1713.8	1808.8	3427.6	3617.6	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	811	1770.0	1865.0	3540.0	3730.0
531	1714.0	1809.0	3428.0	3618.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	812	1770.2	1865.2	3540.4	3730.4
532	1714.2	1809.2	3428.4	3618.4	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	813	1770.4	1865.4	3540.8	3730.8
533	1714.4	1809.4	3428.8	3618.8	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	814	1770.6	1865.6	3541.2	3731.2
534	1714.6	1809.6	3429.2	3619.2	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	815	1770.8	1865.8	3541.6	3731.6
535	1714.8	1809.8	3429.6	3619.6	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	816	1771.0	1866.0	3542.0	3732.0
536	1715.0	1810.0	3430.0	3620.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	817	1771.2	1866.2	3542.4	3732.4
537	1715.2	1810.2	3430.4	3620.4	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	818	1771.4	1866.4	3542.8	3732.8
538	1715.4	1810.4	3430.8	3620.8	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	819	1771.6	1866.6	3543.2	3733.2
539	1715.6	1810.6	3431.2	3621.2	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	820	1771.8	1866.8	3543.6	3733.6
540	1715.8	1810.8	3431.6	3621.6	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	821	1772.0	1867.0	3544.0	3734.0
541	1716.0	1811.0	3432.0	3622.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	822	1772.2	1867.2	3544.4	3734.4
542	1716.2	1811.2	3432.4	3622.4	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	823	1772.4	1867.4	3544.8	3734.8
543	1716.4	1811.4	3432.8	3622.8	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	824	1772.6	1867.6	3545.2	3735.2
544	1716.6	1811.6	3433.2	3623.2	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	825	1772.8	1867.8	3545.6	3735.6
545	1716.8	1811.8	3433.6	3623.6	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	826	1773.0	1868.0	3546.0	3736.0
546	1717.0	1812.0	3434.0	3624.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	827	1773.2	1868.2	3546.4	3736.4
547	1717.2	1812.2	3434.4	3624.4	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	828	1773.4	1868.4	3546.8	3736.8
548	1717.4	1812.4	3434.8	3624.8	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	829	1773.6	1868.6	3547.2	3737.2
549	1717.6	1812.6	3435.2	3625.2	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	830	1773.8	1868.8	3547.6	3737.6
550	1717.8	1812.8	3435.6	3625.6	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	831	1774.0	1869.0	3548.0	3738.0
551	1718.0	1813.0	3436.0	3626.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	832	1774.2	1869.2	3548.4	3738.4
552	1718.2	1813.2	3436.4	3626.4	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	833	1774.4	1869.4	3548.8	3738.8
553	1718.4	1813.4	3436.8	3626.8	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	834	1774.6	1869.6	3549.2	3739.2
554	1718.6	1813.6	3437.2	3627.2	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	835	1774.8	1869.8	3549.6	3739.6
555	1718.8	1813.8	3437.6	3627.6	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	836	1775.0	1870.0	3550.0	3740.0
556	1719.0	1814.0	3438.0	3628.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	837	1775.2	1870.2	3550.4	3740.4
557	1719.2	1814.2	3438.4	3628.4	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	838	1775.4	1870.4	3550.8	3740.8
558	1719.4	1814.4	3438.8	3628.8	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	839	1775.6	1870.6	3551.2	3741.2
559	1719.6	1814.6	3439.2	3629.2	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	840	1775.8	1870.8	3551.6	3741.6
560	1719.8	1814.8	3439.6	3629.6	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	841	1776.0	1871.0	3552.0	3742.0
561	1720.0	1815.0	3440.0	3630.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	842	1776.2	1871.2	3552.4	3742.4
562	1720.2	1815.2	3440.4	3630.4	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	843	1776.4	1871.4	3552.8	3742.8
563	1720.4	1815.4	3440.8	3630.8	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	844	1776.6	1871.6	3553.2	3743.2
564	1720.6	1815.6	3441.2	3631.2	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	845	1776.8	1871.8	3553.6	3743.6
565	1720.8	1815.8	3441.6	3631.6	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	846	1777.0	1872.0	3554.0	3744.0
566	1721.0	1816.0	3442.0	3632.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	847	1777.2	1872.2	3554.4	3744.4
567	1721.2	1816.2	3442.4	3632.4	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	848	1777.4	1872.4	3554.8	3744.8
568	1721.4	1816.4	3442.8	3632.8	662	1740.2	1835.2	3480.4	3670.4	756	1759.0	1854.0	3518.0	3708.0	849	1777.6	1872.6	3555.2	3745.2
569	1721.6	1816.6	3443.2	3633.2	663	1740.4	1835.4	3480.8	3670.8	757	1759.2	1854.2	3518.4	3708.4	850	1777.8	1872.8	3555.6	3745.6
570	1721.8	1816.8	3443.6	3633.6	664	1740.6	1835.6	3481.2	3671.2	758	1759.4	1854.4	3518.8	3708.8	851	1778.0	1873.0	3556.0	3746.0
571	1722.0	1817.0	3444.0	3634.0	665	1740.8	1835.8	3481.6	3671.6	759	1759.6	1854.6	3519.2	3709.2	852	1778.2	1873.2	3556.4	3746.4
572	1722.2	1817.2	3444.4	3634.4	666	1741.0	1836.0	3482.0	3672.0	760	1759.8	1854.8	3519.6	3709.6	853	1778.4	1873.4	3556.8	3746.8
573	1722.4	1817.4	3444.8	3634.8	667	1741.2	1836.2	3482.4	3672.4	761	1760.0	1855.0	3520.0	3710.0	854	1778.6	1873.6	3557.2	3747.2
574	1722.6	1817.6	3445.2	3635.2	668	1741.4	1836.4	3482.8	3672.8	762	1760.2	1855.2	3520.4	3710.4	855	1778.8	1873.8	3557.6	3747.6
575	1722.8	1817.8	3445.6	3635.6	669	1741.6	1836.6	3483.2	3673.2	763	1760.4	1855.4	3520.8	3710.8	856	1779.0	1874.0	3558.0	3748.0
576	1723.0	1818.0	3446.0	3636.0	670	1741.8	1836.8	3483.6	3673.6	764	1760.6	1855.6	3521.2	3711.2	857	1779.2	1874.2	3558.4	3748.4
577	1723.2	1818.2	3446.4	3636.4	671	1742.0	1837.0	3484.0	3674.0	765	1760.8	1855.8	3521.6	3711.6	858	1779.4	1874.4	3558.8	3748.8
578	1723.4	1818.4	3446.8	3636.8	672	1742.2	1837.2	3484.4	3674.4	766	1761.0	1856.0	3522.0	3712.0	859	1779.6	1874.6	3559.2	3749.2
579	1723.6	1818.6	3447.2	3637.2	673	1742.4	1837.4	3484.8	3674.8	767	1761.2	1856.2	3522.4	3712.4	860	1779.8	1874.8	3559.6	3749.6
580	1723.8	1818.8	3447.6	3637.6	674	1742.6	1837.6	3485.2	3675.2	768	1761.4	1856.4	3522.8	3712.8	861	1780.0	1875.0	3560.0	3750.0
581	1724.0	1819.0	3448.0	3638.0	675	1742.8	1837.8	3485.6	3675.6	769	1761.6	1856.6	3523.2	3713.2	862	1780.2	1875.2	3560.4	3750.4
582	1724.2	1819.2	3448.4	3638.4	676	1743.0	1838.0	3486.0	3676.0	770	1761.8	1856.8	3523.6	3713.6	863	1780.4	1875.4	3560.8	3750.8
583	1724.4	1819.4	3448.8	3638.8	677	1743.2	1838.2	3486.4	3676.4	771	1762.0	1857.0	3524.0	3714.0	864	1780.6	1875.6	3561.2	3751.2
584	1724.6	1819.6	3449.2	3639.2	678	1743.4	1838.4	3486.8	3676.8	772	1762.2	1857.2	3524.4	3714.4	865	1780.8	1875.8	3561.6	3751.6
585	1724.8	1819.8	3449.6	3639.6	679	1743.6	1838.6	3487.2	3677.2	773	1762.4	1857.4	3524.8	3714.8	866	1781.0	1876.0	3562.0	3752.0
586	1725.0	1820.0	3450.0	3640.0	680	1743.8	1838.8	3487.6	3677.6	774	1762.6	1857.6	3525.2	3715.2	867	1781.2	1876.2	3562.4	3752.4
587	1725.2	1820.2	3450.4	3640.4	681	1744.0	1839.0	3488.0	3678.0	775	1762.8	1857.8	3525.6	3715.6	868	1781.4	1876.4	3562.8	3752.8
588	1725.4	1820.4	3450.8	3640.8	682	1744.2	1839.2	3488.4	3678.4	776	1763.0	1858.0	3526.0	3716.0	869	1781.6	1876.6	3563.2	3753.2
589	1725.6	1820.6	3451.2	3641.2	683	1744.4	1839.4	3488.8	3678.8	777	1763.2	1858.2	3526.4	3716.4	870	1781.8	1876.8	3563.6	3753.6
590	1725.8	1820.8	3451.6	3641.6	684	1744.6	1839.6	3489.2	3679.2	778	1763.4	1858.4	3526.8	3716.8	871	1782.0	1877.0	3564.0	3754.0
591	1726.0	1821.0	3452.0	3642.0	685	1744.8	1839.8	3489.6	3679.6	779	1763.6	1858.6	3527.2	3717.2	872	1782.2	1877.2	3564.4	3754.4
592	1726.2	1821.2	3452.4	3642.4	686	1745.0	1840.0	3490.0	3680.0	780	1763.8	1858.8	3527.6	3717.6	873	1782.4	1877.4	3564.8	3754.8
593	1726.4	1821.4	3452.8	3642.8	687	1745.2	1840.2	3490.4	3680.4	781	1764.0	1859.0	3528.0	3718.0	874	1782.6	1877.6	3565.2	3755.2
594	1726.6	1821.6	3453.2	3643.2	688	1745.4	1840.4	3490.8	3680.8	782	1764.2	1859.2	3528.4	3718.4	875	1782.8	1877.8	3565.6	3755.6
595	1726.8	1821.8	3453.6	3643.6	689	1745.6	1840.6	3491.2	3681.2	783	1764.4	1859.4	3528.8	3718.8	876	1783.0	1878.0	3566.0	3756.0
596	1727.0	1822.0	3454.0	3644.0	690	1745.8	1840.8	3491.6	3681.6	784	1764.6	1859.6	3529.2	3719.2	877	1783.2	1878.2	3566.4	3756.4
597	1727.2	1822.2	3454.4	3644.4	691	1746.0	1841.0	3492.0	3682.0	785	1764.8	1859.8	3529.6	3719.6	878	1783.4	1878.4	3566.8	3756.8
598	1727.4	1822.4	3454.8	3644.8	692	1746.2	1841.2	3492.4	3682.4	786	1765.0	1860.0	3530.0	3720.0	879	1783.6	1878.6	3567.2	3757.2
599	1727.6	1822.6	3455.2	3645.2	693	1746.4	1841.4	3492.8	3682.8	787	1765.2	1860.2	3530.4	3720.4	880	1783.8	1878.8	3567.6	3757.6
600	1727.8	1822.8	3455.6	3645.6	694	1746.6	1841.6	3493.2	3683.2	788	1765.4	1860.4	3530.8	3720.8	881	1784.0	1879.0	3568.0	3758.0
601	1728.0	1823.0	3456.0	3646.0	695	1746.8	1841.8	3493.6	3683.6	789	1765.6	1860.6	3531.2	3721.2	882	1784.2	1879.2	3568.4	3758.4
602	1728.2	1823.2	3456.4	3646.4	696	1747.0	1842.0	3494.0	3684.0	790	1765.8	1860.8	3531.6	3721.6	883	1784.4	1879.4	3568.8	3758.8
603	1728.4	1823.4	3456.8	3646.8	697	1747.2	1842.2	3494.4	3684.4	791	1766.0	1861.0	3532.0	3722.0	884	1784.6	1879.6	3569.2	3759.2
604	1728.6	1823.6	3457.2	3647.2	698	1747.4	1842.4	3494.8	3684.8	792	1766.2	1861.2	3532.4	3722.4	885	1784.8	1879.8	3569.6	3759.6
605	1728.8	1823.8	3457.6	3647.6	699	1747.6	1842.6	3495.2	3685.2										

GSM1900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6	794	1906,6	1986,6	3813,2	3973,2
513	1850,4	1930,4	3700,8	3860,8	607	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0	795	1906,8	1986,8	3813,6	3973,6
514	1850,6	1930,6	3701,2	3861,2	608	1869,4	1949,4	3738,8	3898,8	702	1888,2	1968,2	3776,4	3936,4	796	1907,0	1987,0	3814,0	3974,0
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8	797	1907,2	1987,2	3814,4	3974,4
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2	798	1907,4	1987,4	3814,8	3974,8
517	1851,2	1931,2	3702,4	3862,4	611	1870,0	1950,0	3740,0	3900,0	705	1888,8	1968,8	3777,6	3937,6	799	1907,6	1987,6	3815,2	3975,2
518	1851,4	1931,4	3702,8	3862,8	612	1870,2	1950,2	3740,4	3900,4	706	1889,0	1969,0	3778,0	3938,0	800	1907,8	1987,8	3815,6	3975,6
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4	801	1908,0	1988,0	3816,0	3976,0
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8	802	1908,2	1988,2	3816,4	3976,4
521	1852,0	1932,0	3704,0	3864,0	615	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2	803	1908,4	1988,4	3816,8	3976,8
522	1852,2	1932,2	3704,4	3864,4	616	1871,0	1951,0	3742,0	3902,0	710	1889,8	1969,8	3779,6	3939,6	804	1908,6	1988,6	3817,2	3977,2
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0	805	1908,8	1988,8	3817,6	3977,6
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4	806	1909,0	1989,0	3818,0	3978,0
525	1852,8	1932,8	3705,6	3865,6	619	1871,6	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8	807	1909,2	1989,2	3818,4	3978,4
526	1853,0	1933,0	3706,0	3866,0	620	1871,8	1951,8	3743,6	3903,6	714	1890,6	1970,6	3781,2	3941,2	808	1909,4	1989,4	3818,8	3978,8
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6	809	1909,6	1989,6	3819,2	3979,2
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0	810	1909,8	1989,8	3819,6	3979,6
529	1853,6	1933,6	3707,2	3867,2	623	1872,4	1952,4	3744,8	3904,8	717	1891,2	1971,2	3782,4	3942,4					
530	1853,8	1933,8	3707,6	3867,6	624	1872,6	1952,6	3745,2	3905,2	718	1891,4	1971,4	3782,8	3942,8					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
533	1854,4	1934,4	3708,8	3868,8	627	1873,2	1953,2	3746,4	3906,4	721	1892,0	1972,0	3784,0	3944,0					
534	1854,6	1934,6	3709,2	3869,2	628	1873,4	1953,4	3746,8	3906,8	722	1892,2	1972,2	3784,4	3944,4					
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
537	1855,2	1935,2	3710,4	3870,4	631	1874,0	1954,0	3748,0	3908,0	725	1892,8	1972,8	3785,6	3945,6					
538	1855,4	1935,4	3710,8	3870,8	632	1874,2	1954,2	3748,4	3908,4	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
541	1856,0	1936,0	3712,0	3872,0	635	1874,8	1954,8	3749,6	3909,6	729	1893,6	1973,6	3787,2	3947,2					
542	1856,2	1936,2	3712,4	3872,4	636	1875,0	1955,0	3750,0	3910,0	730	1893,8	1973,8	3787,6	3947,6					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1856,8	1936,8	3713,6	3873,6	639	1875,6	1955,6	3751,2	3911,2	733	1894,4	1974,4	3788,8	3948,8					
546	1857,0	1937,0	3714,0	3874,0	640	1875,8	1955,8	3751,6	3911,6	734	1894,6	1974,6	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
549	1857,6	1937,6	3715,2	3875,2	643	1876,4	1956,4	3752,8	3912,8	737	1895,2	1975,2	3790,4	3950,4					
550	1857,8	1937,8	3715,6	3875,6	644	1876,6	1956,6	3753,2	3913,2	738	1895,4	1975,4	3790,8	3950,8					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
553	1858,4	1938,4	3716,8	3876,8	647	1877,2	1957,2	3754,4	3914,4	741	1896,0	1976,0	3792,0	3952,0					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,4					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
557	1859,2	1939,2	3718,4	3878,4	651	1878,0	1958,0	3756,0	3916,0	745	1896,8	1976,8	3793,6	3953,6					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3794,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
561	1860,0	1940,0	3720,0	3880,0	655	1878,8	1958,8	3757,6	3917,6	749	1897,6	1977,6	3795,2	3955,2					
562	1860,2	1940,2	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
565	1860,8	1940,8	3721,6	3881,6	659	1879,6	1959,6	3759,2	3919,2	753	1898,4	1978,4	3796,8	3956,8					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568	1861,4	1941,4	3722,8	3882,8	662	1880,2	1960,2	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
569	1861,6	1941,6	3723,2	3883,2	663	1880,4	1960,4	3760,8	3920,8	757	1899,2	1979,2	3798,4	3958,4					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
572	1862,2	1942,2	3724,4	3884,4	666	1881,0	1961,0	3762,0	3922,0	760	1899,8	1979,8	3799,6	3959,6					
573	1862,4	1942,4	3724,8	3884,8	667	1881,2	1961,2	3762,4	3922,4	761	1900,0	1980,0	3800,0	3960,0					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
576	1863,0	1943,0	3726,0	3886,0	670	1881,8	1961,8	3763,6	3923,6	764	1900,6	1980,6	3801,2	3961,2					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3924,0	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
580	1863,8	1943,8	3727,6	3887,6	674	1882,6	1962,6	3765,2	3925,2	768	1901,4	1981,4	3802,8	3962,8					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
584	1864,6	1944,6	3729,2	3889,2	678	1883,4	1963,4	3766,8	3926,8	772	1902,2	1982,2	3804,4	3964,4					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865,2	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	775	1902,8	1982,8	3805,6	3965,6					
588	1865,4	1945,4	3730,8	3890,8	682	1884,2	1964,2	3768,4	3928,4	776	1903,0	1983,0	3806,0	3966,0					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866,0	1946,0	3732,0	3892,0	685	1884,8	1964,8	3769,6	3929,6	779	1903,6	1983,6	3807,2	3967,2					
592	1866,2	1946,2	3732,4	3892,4	686	1885,0	1965,0	3770,0	3930,0	780	1903,8	1983,8	3807,6	3967,6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1866,8	1946,8	3733,6	3893,6	689	1885,6	1965,6	3771,2	3931,2	783	1904,4	1984,4	3808,8	3968,8					
596	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771,6	3931,6	784	1904,6	1984,6	3809,2	3969,2					
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					
599	1867,6	1947,6	3735,2	3895,2	693	1886,4	1966,4	3772,8	3932,8	787	1905,2	1985,2	3810,4	3970,4					
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790	1905,8	1985,8	3811,6	3971,6					
603	1868,4	1948,4	3736,8	3896,8	697	1887,2	1967,2	3774,4	3934,4	791	1906,0	1986,0	3812,0	3972,0					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986,2	3812,4	3972,4					
605	1868,8	1948,8	3737,6	3897,6	699	1887,6	1967,6	3775,2	3935,2	793	1906,4	1986,4	3812,8	3972,8					

WCDMA 2100 Rx frequencies

Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX
10562	2112.4	4224.8	10625	2125	4250	10688	2137.6	4275.2	10751	2150.2	4300.4	10814	2162.8	4325.6
10563	2112.6	4225.2	10626	2125.2	4250.4	10689	2137.8	4275.6	10752	2150.4	4300.8	10815	2163	4326
10564	2112.8	4225.6	10627	2125.4	4250.8	10690	2138	4276	10753	2150.6	4301.2	10816	2163.2	4326.4
10565	2113	4226	10628	2125.6	4251.2	10691	2138.2	4276.4	10754	2150.8	4301.6	10817	2163.4	4326.8
10566	2113.2	4226.4	10629	2125.8	4251.6	10692	2138.4	4276.8	10755	2151	4302	10818	2163.6	4327.2
10567	2113.4	4226.8	10630	2126	4252	10693	2138.6	4277.2	10756	2151.2	4302.4	10819	2163.8	4327.6
10568	2113.6	4227.2	10631	2126.2	4252.4	10694	2138.8	4277.6	10757	2151.4	4302.8	10820	2164	4328
10569	2113.8	4227.6	10632	2126.4	4252.8	10695	2139	4278	10758	2151.6	4303.2	10821	2164.2	4328.4
10570	2114	4228	10633	2126.6	4253.2	10696	2139.2	4278.4	10759	2151.8	4303.6	10822	2164.4	4328.8
10571	2114.2	4228.4	10634	2126.8	4253.6	10697	2139.4	4278.8	10760	2152	4304	10823	2164.6	4329.2
10572	2114.4	4228.8	10635	2127	4254	10698	2139.6	4279.2	10761	2152.2	4304.4	10824	2164.8	4329.6
10573	2114.6	4229.2	10636	2127.2	4254.4	10699	2139.8	4279.6	10762	2152.4	4304.8	10825	2165	4330
10574	2114.8	4229.6	10637	2127.4	4254.8	10700	2140	4280	10763	2152.6	4305.2	10826	2165.2	4330.4
10575	2115	4230	10638	2127.6	4255.2	10701	2140.2	4280.4	10764	2152.8	4305.6	10827	2165.4	4330.8
10576	2115.2	4230.4	10639	2127.8	4255.6	10702	2140.4	4280.8	10765	2153	4306	10828	2165.6	4331.2
10577	2115.4	4230.8	10640	2128	4256	10703	2140.6	4281.2	10766	2153.2	4306.4	10829	2165.8	4331.6
10578	2115.6	4231.2	10641	2128.2	4256.4	10704	2140.8	4281.6	10767	2153.4	4306.8	10830	2166	4332
10579	2115.8	4231.6	10642	2128.4	4256.8	10705	2141	4282	10768	2153.6	4307.2	10831	2166.2	4332.4
10580	2116	4232	10643	2128.6	4257.2	10706	2141.2	4282.4	10769	2153.8	4307.6	10832	2166.4	4332.8
10581	2116.2	4232.4	10644	2128.8	4257.6	10707	2141.4	4282.8	10770	2154	4308	10833	2166.6	4333.2
10582	2116.4	4232.8	10645	2129	4258	10708	2141.6	4283.2	10771	2154.2	4308.4	10834	2166.8	4333.6
10583	2116.6	4233.2	10646	2129.2	4258.4	10709	2141.8	4283.6	10772	2154.4	4308.8	10835	2167	4334
10584	2116.8	4233.6	10647	2129.4	4258.8	10710	2142	4284	10773	2154.6	4309.2	10836	2167.2	4334.4
10585	2117	4234	10648	2129.6	4259.2	10711	2142.2	4284.4	10774	2154.8	4309.6	10837	2167.4	4334.8
10586	2117.2	4234.4	10649	2129.8	4259.6	10712	2142.4	4284.8	10775	2155	4310	10838	2167.6	4335.2
10587	2117.4	4234.8	10650	2130	4260	10713	2142.6	4285.2	10776	2155.2	4310.4			
10588	2117.6	4235.2	10651	2130.2	4260.4	10714	2142.8	4285.6	10777	2155.4	4310.8			
10589	2117.8	4235.6	10652	2130.4	4260.8	10715	2143	4286	10778	2155.6	4311.2			
10590	2118	4236	10653	2130.6	4261.2	10716	2143.2	4286.4	10779	2155.8	4311.6			
10591	2118.2	4236.4	10654	2130.8	4261.6	10717	2143.4	4286.8	10780	2156	4312			
10592	2118.4	4236.8	10655	2131	4262	10718	2143.6	4287.2	10781	2156.2	4312.4			
10593	2118.6	4237.2	10656	2131.2	4262.4	10719	2143.8	4287.6	10782	2156.4	4312.8			
10594	2118.8	4237.6	10657	2131.4	4262.8	10720	2144	4288	10783	2156.6	4313.2			
10595	2119	4238	10658	2131.6	4263.2	10721	2144.2	4288.4	10784	2156.8	4313.6			
10596	2119.2	4238.4	10659	2131.8	4263.6	10722	2144.4	4288.8	10785	2157	4314			
10597	2119.4	4238.8	10660	2132	4264	10723	2144.6	4289.2	10786	2157.2	4314.4			
10598	2119.6	4239.2	10661	2132.2	4264.4	10724	2144.8	4289.6	10787	2157.4	4314.8			
10599	2119.8	4239.6	10662	2132.4	4264.8	10725	2145	4290	10788	2157.6	4315.2			
10600	2120	4240	10663	2132.6	4265.2	10726	2145.2	4290.4	10789	2157.8	4315.6			
10601	2120.2	4240.4	10664	2132.8	4265.6	10727	2145.4	4290.8	10790	2158	4316			
10602	2120.4	4240.8	10665	2133	4266	10728	2145.6	4291.2	10791	2158.2	4316.4			
10603	2120.6	4241.2	10666	2133.2	4266.4	10729	2145.8	4291.6	10792	2158.4	4316.8			
10604	2120.8	4241.6	10667	2133.4	4266.8	10730	2146	4292	10793	2158.6	4317.2			
10605	2121	4242	10668	2133.6	4267.2	10731	2146.2	4292.4	10794	2158.8	4317.6			
10606	2121.2	4242.4	10669	2133.8	4267.6	10732	2146.4	4292.8	10795	2159	4318			
10607	2121.4	4242.8	10670	2134	4268	10733	2146.6	4293.2	10796	2159.2	4318.4			
10608	2121.6	4243.2	10671	2134.2	4268.4	10734	2146.8	4293.6	10797	2159.4	4318.8			
10609	2121.8	4243.6	10672	2134.4	4268.8	10735	2147	4294	10798	2159.6	4319.2			
10610	2122	4244	10673	2134.6	4269.2	10736	2147.2	4294.4	10799	2159.8	4319.6			
10611	2122.2	4244.4	10674	2134.8	4269.6	10737	2147.4	4294.8	10800	2160	4320			
10612	2122.4	4244.8	10675	2135	4270	10738	2147.6	4295.2	10801	2160.2	4320.4			
10613	2122.6	4245.2	10676	2135.2	4270.4	10739	2147.8	4295.6	10802	2160.4	4320.8			
10614	2122.8	4245.6	10677	2135.4	4270.8	10740	2148	4296	10803	2160.6	4321.2			
10615	2123	4246	10678	2135.6	4271.2	10741	2148.2	4296.4	10804	2160.8	4321.6			
10616	2123.2	4246.4	10679	2135.8	4271.6	10742	2148.4	4296.8	10805	2161	4322			
10617	2123.4	4246.8	10680	2136	4272	10743	2148.6	4297.2	10806	2161.2	4322.4			
10618	2123.6	4247.2	10681	2136.2	4272.4	10744	2148.8	4297.6	10807	2161.4	4322.8			
10619	2123.8	4247.6	10682	2136.4	4272.8	10745	2149	4298	10808	2161.6	4323.2			
10620	2124	4248	10683	2136.6	4273.2	10746	2149.2	4298.4	10809	2161.8	4323.6			
10621	2124.2	4248.4	10684	2136.8	4273.6	10747	2149.4	4298.8	10810	2162	4324			
10622	2124.4	4248.8	10685	2137	4274	10748	2149.6	4299.2	10811	2162.2	4324.4			
10623	2124.6	4249.2	10686	2137.2	4274.4	10749	2149.8	4299.6	10812	2162.4	4324.8			
10624	2124.8	4249.6	10687	2137.4	4274.8	10750	2150	4300	10813	2162.6	4325.2			

WCDMA 2100 Tx frequencies

Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx
9612	1922.4	3844.8	9671	1934.2	3868.4	9730	1946	3892	9789	1957.8	3915.6	9848	1969.6	3939.2
9613	1922.6	3845.2	9672	1934.4	3868.8	9731	1946.2	3892.4	9790	1958	3916	9849	1969.8	3939.6
9614	1922.8	3845.6	9673	1934.6	3869.2	9732	1946.4	3892.8	9791	1958.2	3916.4	9850	1970	3940
9615	1923	3846	9674	1934.8	3869.6	9733	1946.6	3893.2	9792	1958.4	3916.8	9851	1970.2	3940.4
9616	1923.2	3846.4	9675	1935	3870	9734	1946.8	3893.6	9793	1958.6	3917.2	9852	1970.4	3940.8
9617	1923.4	3846.8	9676	1935.2	3870.4	9735	1947	3894	9794	1958.8	3917.6	9853	1970.6	3941.2
9618	1923.6	3847.2	9677	1935.4	3870.8	9736	1947.2	3894.4	9795	1959	3918	9854	1970.8	3941.6
9619	1923.8	3847.6	9678	1935.6	3871.2	9737	1947.4	3894.8	9796	1959.2	3918.4	9855	1971	3942
9620	1924	3848	9679	1935.8	3871.6	9738	1947.6	3895.2	9797	1959.4	3918.8	9856	1971.2	3942.4
9621	1924.2	3848.4	9680	1936	3872	9739	1947.8	3895.6	9798	1959.6	3919.2	9857	1971.4	3942.8
9622	1924.4	3848.8	9681	1936.2	3872.4	9740	1948	3896	9799	1959.8	3919.6	9858	1971.6	3943.2
9623	1924.6	3849.2	9682	1936.4	3872.8	9741	1948.2	3896.4	9800	1960	3920	9859	1971.8	3943.6
9624	1924.8	3849.6	9683	1936.6	3873.2	9742	1948.4	3896.8	9801	1960.2	3920.4	9860	1972	3944
9625	1925	3850	9684	1936.8	3873.6	9743	1948.6	3897.2	9802	1960.4	3920.8	9861	1972.2	3944.4
9626	1925.2	3850.4	9685	1937	3874	9744	1948.8	3897.6	9803	1960.6	3921.2	9862	1972.4	3944.8
9627	1925.4	3850.8	9686	1937.2	3874.4	9745	1949	3898	9804	1960.8	3921.6	9863	1972.6	3945.2
9628	1925.6	3851.2	9687	1937.4	3874.8	9746	1949.2	3898.4	9805	1961	3922	9864	1972.8	3945.6
9629	1925.8	3851.6	9688	1937.6	3875.2	9747	1949.4	3898.8	9806	1961.2	3922.4	9865	1973	3946
9630	1926	3852	9689	1937.8	3875.6	9748	1949.6	3899.2	9807	1961.4	3922.8	9866	1973.2	3946.4
9631	1926.2	3852.4	9690	1938	3876	9749	1949.8	3899.6	9808	1961.6	3923.2	9867	1973.4	3946.8
9632	1926.4	3852.8	9691	1938.2	3876.4	9750	1950	3900	9809	1961.8	3923.6	9868	1973.6	3947.2
9633	1926.6	3853.2	9692	1938.4	3876.8	9751	1950.2	3900.4	9810	1962	3924	9869	1973.8	3947.6
9634	1926.8	3853.6	9693	1938.6	3877.2	9752	1950.4	3900.8	9811	1962.2	3924.4	9870	1974	3948
9635	1927	3854	9694	1938.8	3877.6	9753	1950.6	3901.2	9812	1962.4	3924.8	9871	1974.2	3948.4
9636	1927.2	3854.4	9695	1939	3878	9754	1950.8	3901.6	9813	1962.6	3925.2	9872	1974.4	3948.8
9637	1927.4	3854.8	9696	1939.2	3878.4	9755	1951	3902	9814	1962.8	3925.6	9873	1974.6	3949.2
9638	1927.6	3855.2	9697	1939.4	3878.8	9756	1951.2	3902.4	9815	1963	3926	9874	1974.8	3949.6
9639	1927.8	3855.6	9698	1939.6	3879.2	9757	1951.4	3902.8	9816	1963.2	3926.4	9875	1975	3950
9640	1928	3856	9699	1939.8	3879.6	9758	1951.6	3903.2	9817	1963.4	3926.8	9876	1975.2	3950.4
9641	1928.2	3856.4	9700	1940	3880	9759	1951.8	3903.6	9818	1963.6	3927.2	9877	1975.4	3950.8
9642	1928.4	3856.8	9701	1940.2	3880.4	9760	1952	3904	9819	1963.8	3927.6	9878	1975.6	3951.2
9643	1928.6	3857.2	9702	1940.4	3880.8	9761	1952.2	3904.4	9820	1964	3928	9879	1975.8	3951.6
9644	1928.8	3857.6	9703	1940.6	3881.2	9762	1952.4	3904.8	9821	1964.2	3928.4	9880	1976	3952
9645	1929	3858	9704	1940.8	3881.6	9763	1952.6	3905.2	9822	1964.4	3928.8	9881	1976.2	3952.4
9646	1929.2	3858.4	9705	1941	3882	9764	1952.8	3905.6	9823	1964.6	3929.2	9882	1976.4	3952.8
9647	1929.4	3858.8	9706	1941.2	3882.4	9765	1953	3906	9824	1964.8	3929.6	9883	1976.6	3953.2
9648	1929.6	3859.2	9707	1941.4	3882.8	9766	1953.2	3906.4	9825	1965	3930	9884	1976.8	3953.6
9649	1929.8	3859.6	9708	1941.6	3883.2	9767	1953.4	3906.8	9826	1965.2	3930.4	9885	1977	3954
9650	1930	3860	9709	1941.8	3883.6	9768	1953.6	3907.2	9827	1965.4	3930.8	9886	1977.2	3954.4
9651	1930.2	3860.4	9710	1942	3884	9769	1953.8	3907.6	9828	1965.6	3931.2	9887	1977.4	3954.8
9652	1930.4	3860.8	9711	1942.2	3884.4	9770	1954	3908	9829	1965.8	3931.6	9888	1977.6	3955.2
9653	1930.6	3861.2	9712	1942.4	3884.8	9771	1954.2	3908.4	9830	1966	3932			
9654	1930.8	3861.6	9713	1942.6	3885.2	9772	1954.4	3908.8	9831	1966.2	3932.4			
9655	1931	3862	9714	1942.8	3885.6	9773	1954.6	3909.2	9832	1966.4	3932.8			
9656	1931.2	3862.4	9715	1943	3886	9774	1954.8	3909.6	9833	1966.6	3933.2			
9657	1931.4	3862.8	9716	1943.2	3886.4	9775	1955	3910	9834	1966.8	3933.6			
9658	1931.6	3863.2	9717	1943.4	3886.8	9776	1955.2	3910.4	9835	1967	3934			
9659	1931.8	3863.6	9718	1943.6	3887.2	9777	1955.4	3910.8	9836	1967.2	3934.4			
9660	1932	3864	9719	1943.8	3887.6	9778	1955.6	3911.2	9837	1967.4	3934.8			
9661	1932.2	3864.4	9720	1944	3888	9779	1955.8	3911.6	9838	1967.6	3935.2			
9662	1932.4	3864.8	9721	1944.2	3888.4	9780	1956	3912	9839	1967.8	3935.6			
9663	1932.6	3865.2	9722	1944.4	3888.8	9781	1956.2	3912.4	9840	1968	3936			
9664	1932.8	3865.6	9723	1944.6	3889.2	9782	1956.4	3912.8	9841	1968.2	3936.4			
9665	1933	3866	9724	1944.8	3889.6	9783	1956.6	3913.2	9842	1968.4	3936.8			
9666	1933.2	3866.4	9725	1945	3890	9784	1956.8	3913.6	9843	1968.6	3937.2			
9667	1933.4	3866.8	9726	1945.2	3890.4	9785	1957	3914	9844	1968.8	3937.6			
9668	1933.6	3867.2	9727	1945.4	3890.8	9786	1957.2	3914.4	9845	1969	3938			
9669	1933.8	3867.6	9728	1945.6	3891.2	9787	1957.4	3914.8	9846	1969.2	3938.4			
9670	1934	3868	9729	1945.8	3891.6	9788	1957.6	3915.2	9847	1969.4	3938.8			

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Glossary

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A/D-converter	Analog-to-digital converter
ACI	Accessory Control Interface
ADC	Analog-to-digital converter
ADSP	Application DPS (expected to run high level tasks)
AGC	Automatic gain control (maintains volume)
ALS	Ambient light sensor
AMSL	After Market Service Leader
ARM	Advanced RISC Machines
ARPU	Average revenue per user (per month or per year)
ASIC	Application Specific Integrated Circuit
ASIP	Application Specific Interface Protector
B2B	Board to board, connector between PWB and UI board
BB	Baseband
BC02	Bluetooth module made by CSR
BIQUAD	Bi-quadratic ,type of filter function)
BSI	Battery Size Indicator
BT	Bluetooth
CBus	MCU controlled serial bus connected to UPP_WD2,UEME and Zocus
CCP	Compact Camera Port
CDSP	Cellular DSP (expected to run at low levels)
CLDC	Connected limited device configuration
CMOS	Complimentary metal-oxide semiconductor circuit (low power consumption)
COF	Chip on Foil
COG	Chip on Glass
CPU	Central Processing Unit
CSR	cambridge silicon radio
CSTN	Color Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analouge converter
DAC	Digital-to-analouge converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo
DCT-4	Digital Core Technology
DMA	Direct memory access
DP	Data Package

DPLL	Digital Phase Locked Loop
DSP	Digital Signal Processor
DtoS	Differential to Single ended
EDGE	Enhanced data rates for global/GSM evaluation
EGSM	Extended GSM
EM	Energy management
EMC	Electromagnetic compability
EMI	Electromagnetic interference
ESD	Electrostatic discharge
FCI	Functional cover interface
FPS	Flash Programming Tool
FR	Full rate
FSTN	Film compensated super twisted nematic
GND	Ground, conductive mass
GPIB	General-purpose interface bus
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global System for Mobile communication
HF	Hands free
HFCM	Handsfree Common
HS	Handset
HSCSD	High speed circuit switched data (data transmission connection faster than GSM)
HW	Hardware
I/O	Input/Output
IBAT	Battery current
IC	Integrated circuit
ICHAR	Charger current
IF	Interface
IHF	Integrated hands free
IMEI	International Mobile Equipment Identity
IR	Infrared
IrDA	Infrared Data Associasion
ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out
LED	Light-emitting diode

LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
NTC	Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor
OMA	Object management architechture
OMAP	Operations, maintenance, and administartion part
Opamp	Operational Amplifier
PA	Power amplifier
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board
PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RF	Radio Frequency
RF PopPort TM	Reduced function PopPortTM interface
RFBUS	Serial control Bus For RF
RSK	Right Soft Key
RS-MMC	Reduced size Multi Media Card
RSSI	Receiving signal strength indicator
RST	Reset Switch
RTC	Real Time Clock (provides date and time)
RX	Radio Receiver

SARAM	Single Access RAM
SAW filter	Surface Acoustic Wave filter
SDRAM	Synchronous Dynamic Random Access Memory
SID	Security ID
SIM	Subscriber Identity Module
SMPS	Switched Mode Power Supply
SNR	Signal-to-noice ratio
SPR	Standard Product requirements
SRAM	Static random access memory
STI	Serial Trace Interface
SW	Software
SWIM	Subscriber/Wallet Identification Module
TCXO	Temperature controlled Oscillator
Tiku	Finnish for Chip, Successor of the UPP
TX	Radio Transmitter
UART	Universal asynchronous receiver/transmitter
UEME	Universal Energy Management chip (Enhanced version)
UEMEK	See UEME
UI	User Interface
UPP	Universal Phone Processor
UPP_WD2	Communicator version of DCT4 system ASIC
USB	Universal Serial Bus
VBAT	Battery voltage
VCHAR	Charger voltage
VCO	Voltage controlled oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VCXO	Voltage Controlled Crystal Oscillator
Vp-p	Peak-to-peak voltage
VSIM	SIM voltage
WAP	Wireless application protocol
WD	Watchdog
XHTML	Extensible hypertext markup language
Zocus	Current sensor, (used to monitor the current flow to and from the battery)